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Bird and Bat Risk Assessment: A Weight-of-Evidence Approach to Assessing Risk to Birds and Bats at the Proposed Kingdom Community Wind Project, Lowell, Vermont

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Executive Summary

An Ecological Risk Assessment was performed by Stantec Consulting Services Inc. (Stantec), during winter 2010 to evaluate potential impacts to avian and bat resources from both the construction and operation of the proposed Kingdom Community Wind Project (the Project, KCW) in Lowell, Vermont. Acting on behalf of Green Mountain Power (GMP), Vermont Environmental Research Associates (VERA) contracted Stantec to conduct ecological surveys in the Project area to document biological activity of birds and bats. The surveys are part of the planning process by KCW for a proposed wind energy project that will include 20 to 21, 2.5 to 3.0 megawatt (MW) turbines along 3.2 miles of the Lowell Mountains ridgeline.

A qualitative weight-of-evidence technique was used in this risk assessment, as it is currently not possible to quantitatively assess risk to birds and bats in the pre-construction phase given the existing technology and methodologies available. Using this technique, the results of field surveys, regional data, literature review, and database review were evaluated for their indication of risk to birds and bats from direct and indirect impacts. The strengths and weaknesses of each source of data were also evaluated to assign a level of confidence or certainty to the assessment of risk derived from each data type. While statements of risk included in this report are made with some uncertainty, results from the weight-of-evidence assessment provide a thorough summary of the current understanding of potential risks to raptors, nocturnally migrating passerines, breeding birds, and bats. The document is organized based on these four avian and bat groups. Each is addressed separately within the results and discussion sections.

The risk assessment used information from a literature review of regional surveys and databases, and on-site field surveys to characterize use of the Project area by raptors, nocturnally migrating passerines, breeding birds, and bats. Field surveys used in preparing the risk assessment included: nocturnal radar surveys conducted in fall 2008 and spring 2009; a breeding bird survey and a Bicknell's thrush playback survey conducted in summer 2009; a diurnal raptor survey conducted in spring 2009; an acoustic bat survey conducted in 2009; and an eastern small-footed bat habitat assessment conducted in fall 2009. Detailed descriptions of methods and results of these surveys are provided in a separate seasonal survey report titled Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont (Stantec 2009a).

Potential impacts to raptors are expected to be minor. Relatively low numbers of raptors appear to pass over the Project area during the spring migration period, and no breeding raptors were detected during breeding bird surveys. One bald eagle (*Haliaeetus leucocephalus*) was observed 3,500 feet (1,067 meters [m]) outside the project area, at a height of approximately 500 m above ground level, during on-site surveys. Regional databases identified two peregrine falcon (*Falco peregrinus*) eyries, in the vicinity of, but outside of the Project area. Regional databases also documented both bald eagles and golden eagles (*Aquila chrysaetos*) in the vicinity of the Project area during the spring and fall migration periods. However, post-construction studies and other literature on raptor collision mortality in the U.S. (outside of California) have documented low raptor fatality numbers and high rates of turbine avoidance behavior, and suggest that raptors are generally not vulnerable to impacts associated with collision mortality at modern wind facilities. On-site raptor migration surveys documented low to moderate numbers of raptors passing through the Project area, with some birds occurring at locations within the proposed rotor-swept zones, indicating a potential for collision events to occur; however, low numbers observed suggest a low magnitude of impacts. Literature review and habitat assessments both indicated a potential for indirect impacts, as any type of habitat modification or land clearing can be expected to affect the distribution and species composition of raptors in the immediate area. However, the magnitude of this impact is expected to be low, as the amount of land clearing associated with the Project will be minimal in comparison to the amount of available habitat and will result in habitat alterations similar to those already present in the landscape. Overall, all measurement endpoints indicated a potential risk of direct and indirect impacts, as raptors do migrate through the Project area and the Project will result in a certain amount of forest clearing, but the magnitude of impact would be low.

Potential impacts to nocturnally migrating passerines are expected to be minor. Although on-site field surveys documented nocturnally migrating passerines moving through the Project area in relatively low to moderate numbers compared to regional survey results, the vast majority of individuals were are flying at consistently high altitudes above the height of the proposed turbines. Literature review suggested that impacts to nocturnally migrating passerines do occur at most wind energy facilities. However, the magnitude of impacts are likely low, since the number of individuals that have collided with turbines is very small relative to the large number of individuals moving through the landscape, and as compared to regional population levels. Patterns of mortality (species composition, seasonal timing) are expected to be similar to operational projects in New England where mortality has been relatively low. Overall, both measurement endpoints indicated a potential for direct impacts, as nocturnally migrating passerines do migrate through the Project area, but the magnitude of impact should be low, since the majority are flying at heights above the proposed turbine height, and since rates of collision appear to be low relative to the regional population size.

Potential impacts to breeding birds are expected to be minor. On-site breeding bird surveys documented typical abundances and species composition of breeding birds. Based on comparison to regional surveys conducted in at lower elevations in adjacent valleys with more diverse habitats, breeding bird diversity is relatively low within the Project area. Literature review suggested that while collision mortality has been documented for breeding birds at existing facilities, birds seem to be less prone to collision during the breeding season than during the spring and fall migration. Indirect impacts to breeding birds associated with habitat conversion are expected to cause limited shifts in species distribution and abundance and are expected to affect certain species more than others. Breeding bird habitat currently within the Project area consists of a mosaic of second growth and successional forest with a history of timber harvests. Because many of the common species in the Project area are edge-associated species, typically inhabiting areas with human activity, many breeding bird species are expected to become habituated to the presence of the turbines. Certain forest interior species may be indirectly impacted by the Project. However, overall indirect impacts to breeding birds are expected to be minimal, and the type of clearing associated with the Project is not expected to dramatically alter the breeding bird community in the Project area. All measurement endpoints used to assess potential direct and indirect impacts predicted that, while impacts could occur, the magnitude of these impacts is expected to be low. Furthermore, no federally or state listed threatened or endangered species were observed in the Project area during breeding bird surveys.

Potential impacts to bats are expected to be low to moderate. Results from post-construction surveys at existing facilities indicated that potential impacts to bats consist largely of collision mortality. While collision mortality has been documented at operational wind facilities during summer, and bats likely reside within the Project area between early spring and late fall, bats seem most vulnerable to collision during the fall migration period, based on regional post-construction results. Long-distance migratory bat species have comprised the majority of fatalities at most operational facilities in the Northeast, although there is variability in rates of mortality and species composition at different sites. On-site acoustic surveys documented presence of bat species or species groups typical to the area. Silver-haired bats (*Lasionycteris noctivagans*), one of three long-distance migratory species found in Vermont, were well represented in the results of on-site acoustic surveys, particularly at detectors surveying airspace at or above tree canopy. Therefore, literature review and acoustic surveys both indicated a potential for direct impacts, since some bats are killed at most wind facilities in the Northeast and presence of bat species indicates potential risk, although low overall rates of acoustic activity above tree canopy may indicate a low magnitude of direct impacts. Literature review and habitat assessments both indicated a potential for indirect impacts, as removal of roost habitat is likely not outweighed by creation of additional foraging habitat associated with turbine pad clearings. However, the magnitude of indirect impacts is expected to be low, given the relatively low amount of anticipated clearing, the large forest blocks surrounding the Project area that could compensate for roosting habitat lost during clearing, and the currently disturbed nature of some habitats within the Project area as a result of current timber harvest activities. Therefore, all measurement endpoints used to assess potential direct and indirect impacts to bats predicted that impacts will occur. Impacts are expected to be greatest during the late summer and early fall migratory season, and to long-distance migratory bat species, based on the timing of acoustic activity at the Project as well as patterns observed at operational sites in the eastern U.S., including sites in New England. Patterns of collision mortality are expected to be most similar to operational projects in New England, where topography and habitat are most similar to the Project, and where low levels of bat mortality have been documented.

High evidence of impact was not found for any group of species examined in this document. On-site surveys and results of post-construction monitoring at existing wind projects suggests that raptors and breeding birds will have a low risk of direct and indirect impacts from the Project. Direct impacts in the form of collision mortality are expected for nocturnally migrating songbirds and bats, with impacts occurring primarily during the fall migration period. Potential impacts to endangered species are expected to be very low. No state or federal threatened or endangered breeding bird species were observed during breeding bird surveys. One bald eagle (state endangered species) was observed during raptor surveys, but the observation was outside the project area, and no bald eagles were observed during breeding bird surveys. Furthermore, raptors as a group are expected to experience low direct and indirect impacts given their low rates of collision mortality, high rates of turbine avoidance behavior, and the small amount of land clearing for the Project in comparison to the amount of surrounding habitat. The Indiana bat is the only endangered bat species in Vermont, and its range does not include the Project area. The small-footed bat is state listed as threatened, and its known range does include the Project area. No potential roosting sites were identified during the remote habitat analysis; therefore it is unlikely that there will be an impact to roost habitat for this species.

Overall, the impacts to birds and bats expected at the Kingdom Community Wind Project are not unique to this Project, and are expected to be similar to those at other projects located in areas with similar habitat and topography. Existing facilities in New England, where topography and habitat are most similar to the Project area, have documented low levels of nocturnally migrating passerine and bat mortality relative to facilities outside of New England. The results of this weight-of-evidence process provide a thorough summary of the current understanding of potential risks to the species groups evaluated.

Table of Contents

Tables

Figures

Appendices

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1.0 Introduction

Field surveys designed to assess bird and bat activity are often conducted at proposed wind facilities in order to provide information on species composition and activity patterns. These surveys provide vital information on species or species groups present in the area prior to construction. However, there is currently no way of using data collected pre-construction to quantitatively predict impacts to birds and bats as a result of facility construction (Cryan and Barclay 2009, Kunz *et al*. 2007a, 2007b). The primary difficulties encountered in quantitatively predicting risk of collision mortality and indirect impacts associated with wind facilities include the lack of understanding of factors causing birds and bats to collide with wind turbines, the influence site location may have on collision factors, and the inadequately established relationship between pre-construction and post-construction survey results. Furthermore, lack of information on population size for some species groups (particularly bat species), and limitations in existing survey technologies that often prevent precise species identification or calculations of local abundance, limit the inferences that can be made regarding population-level impacts.

Although quantitative predictions of mortality rates cannot be made on a site-specific basis, an ecological risk assessment (ERA) can be used to supplement survey results at a site in order to qualitatively predict risk to general species groups. Unlike traditional ecological risk assessments, in which a stressor is present in a measurable quantity and potential effects of this stressor on various species or communities have been described, risk assessments for wind energy projects involve a stressor (wind facilities) that is not yet present in the landscape. However, the risk assessment approach provides a framework for systematic analysis and standardized documentation that elucidates the factors considered in the evaluation process. This document will serve as a screening-level, modified ecological risk assessment and follows a conservative, qualitative approach to predicting levels of risk to various bird and bat groups. This approach uses a weight-of-evidence (WOE) framework that simultaneously evaluates multiple, diverse survey methods and considers the strengths and weaknesses of each. Level of risk for each species or group evaluated is predicted by taking into account its relative abundance in the Project area, the likelihood of exposure to wind turbines, and patterns of impact to the particular species or group as documented at existing wind projects. The WOE approach was selected for this risk assessment because it is well suited to make the most appropriate use of a variety of types of data with ranging quality and applicability, and was identified as a frequently used method in a draft document prepared by the National Wind Coordinating Committee (NWCC) on the applicability of ERA to wind projects (Kunz *et al.* 2007b).

Potential ecological impacts to birds and bats associated with wind projects can be divided into two primary categories: direct impacts involving collision mortality with turbine blades, towers, and associated structures, and indirect impacts such as habitat loss and displacement from areas containing turbines. Stantec Consulting Services Inc. (Stantec) conducted a variety of field surveys between 2008 and 2009 in order to characterize species composition and activity patterns of birds and bats at the proposed Kingdom Community Wind Project (the Project). The Project is located on the Lowell Mountain ridgeline in Orleans County, Vermont. Methods, results, and discussion of each survey are summarized in detail in Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont (Stantec 2009a).

The purpose of this document is to provide a summary of information obtained from literature review, regional surveys and database review, and site-specific pre-construction field surveys to evaluate potential impacts to birds and bats from construction and operation of the Project. The document is organized based on four avian and bat groups: raptors, nocturnally migrating passerines, breeding birds, and bats. Each category is further divided into sections discussing particular species or guilds within the group. Following analysis of the results of on-site field surveys, Stantec reviewed available information regarding the abundance, distribution, and species composition of birds and bats in the Project area, synthesized this information with results of on-site surveys, reviewed known patterns of collision mortality at existing wind farms for each group, and finally incorporated this information into this risk assessment.

The WOE approach has been used by Stantec to assess risk at the Rollins Wind Project in Maine (Stantec 2009b) and two projects in the Mid-Atlantic (New Creek Mountain [Stantec 2008a] and Laurel Mountain [Stantec 2008b], West Virginia), where this approach has been accepted by regional regulatory agencies. This assessment provides a standardized approach to assessing risk to birds and bats from the project by incorporating a variety of lines of evidence and their strengths and weaknesses. It provides descriptions of each line of evidence used and the process in which conclusions about risk were reached.

1.1 PROJECT AREA DESCRIPTION

The proposed Project area is located along approximately 3.2 miles ([mi]; 5.1 kilometers [km]) of the Lowell Mountain ridgeline, located in the town of Lowell, in southwestern Orleans County, Vermont (Figure 1-1). The Lowell Mountain range lies within the Northern Green Mountains biophysical region (Thompson and Sorenson 2000). This area of the Green Mountains can be divided into several distinct ranges; the Lowell Mountain range lies to the east of the main Green Mountain spine, and runs northeast to southwest from Lake Memphremagog to the town of Eden. The topography in this region is variable, ranging from 2,190 feet (') to 2,640' above sea level along the length of ridgeline on which wind turbines will be installed, to 1,148' to 1,476' along valley floors to the northwest and southeast. Several streams run down the steeper southeastern slope to the Black River, while streams on the shallower northwest slope converge on the East Branch of the Missisquoi River.

Habitats in the Project area are typical of higher elevations communities in the Northern Green Mountains biophysical region. The lowest elevations are dominated by Northern Hardwood Forest, with American beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*), and sugar maple (*Acer saccharum*) as the most common species. This gives way to Montane Yellow Birch-Red Spruce Forest, with Montane Spruce-Fir Forest evident at the highest elevations.

The Project will support 20 to 21 turbines along the ridgeline. The turbines will likely be 2.5 to 3.0 megawatt (MW) machines mounted on tubular steel towers with an approximate height ranging from 410' (125 meters [m]) to 443' (135 m) from ground level to the tip of a blade at its highest position. For the purposes of describing raptor, nocturnal migrant, breeding bird, and bat activity in the vicinity of and within the Project area, the Project area refers to the proposed turbine area and access road as depicted in Figure 1-1. Stantec on-site field surveys (raptor, radar, breeding bird, and acoustic surveys) utilized equipment or observation points located within the Project area. Each survey type sampled a unique amount of area surrounding the equipment or observation location. Figure 1-2 shows a broad perspective of regional survey locations, including regional data obtained during literature review and database review.

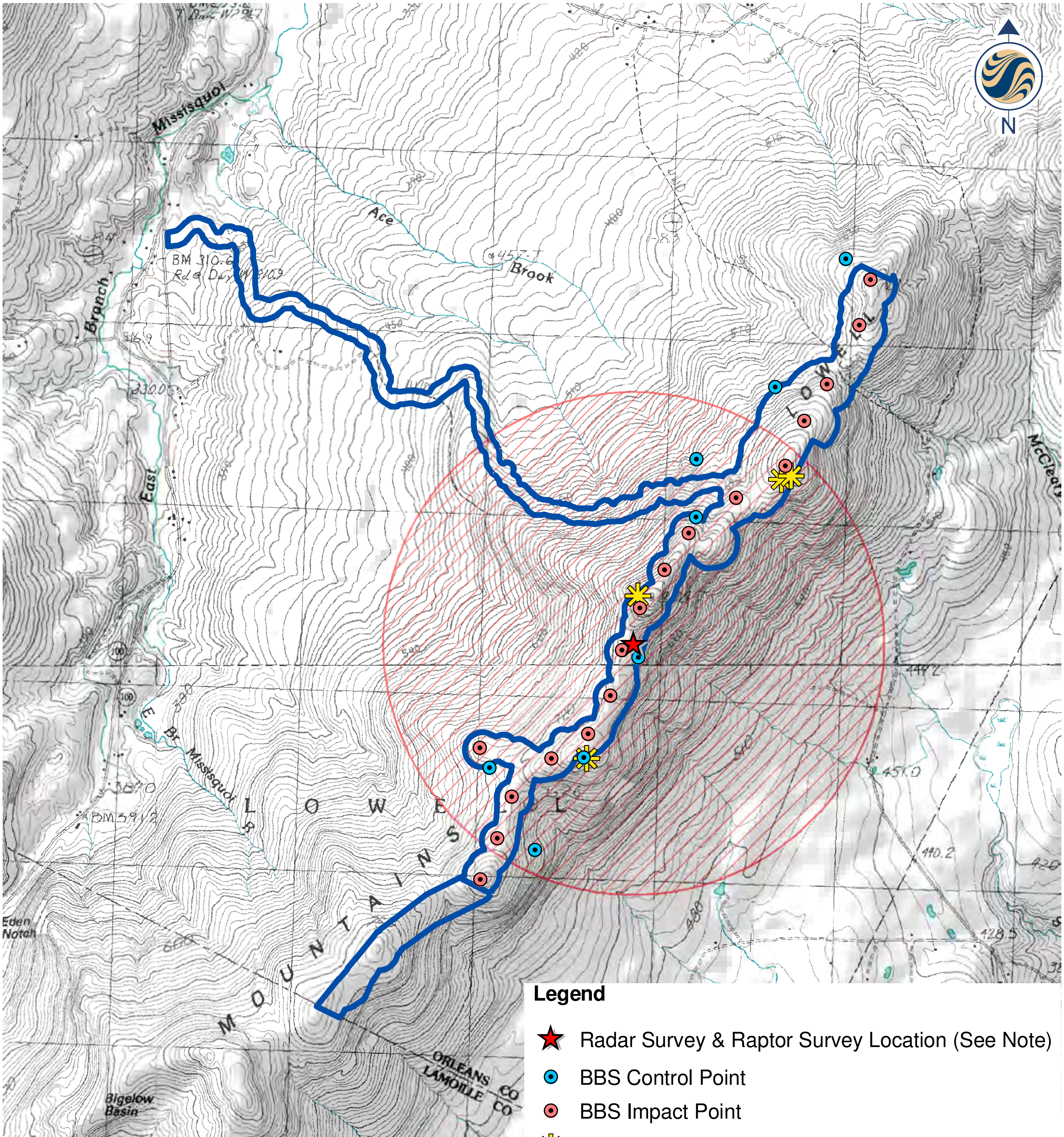
2.0 Methods

2.1 INFORMATION REVIEW

For each avian and bat species group discussed in this ERA, Stantec reviewed available sources of data on distribution, abundance, and species composition in the vicinity of the Project area, as they relate to direct or indirect impacts with wind energy facilities. Data sources included literature, regional survey data, and online databases. The quantity and relevance of these data varied by species group and included sources such as results of Christmas Bird Counts (CBC), Breeding Bird Survey (BBS) routes, the Cornell Lab of Ornithology and National Audubon Society's online checklist program (eBird), and results of Hawk Migration Association of North America (HMANA) counts. Relevant scientific literature was used to determine known habitat associations and distribution and abundance of various species. Specific types of information used for each group are identified in the corresponding results sections of this report.

2.2 FIELD SURVEYS

A variety of on-site field surveys were conducted in the Project area between September 2008 and October 2009. Surveys were conducted primarily during the spring and fall migration periods, and included raptor migration surveys, nocturnal marine radar surveys, breeding bird surveys, acoustic bat surveys, and an eastern small-footed bat (*Myotis leibii*) habitat assessment. Dates of various field surveys conducted in the Project area are summarized in Table 2-1.



Legend

- Radar Survey & Raptor Survey Location (See Note)
- BBS Control Point
- BBS Impact Point
- Bat Detector Location
- August 2009 Project Area
- Horizontal Radar Detection Range

0 0.5
Miles

NOTE: Raptor Survey area equal to area visible from this point using 10X binoculars.

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Client/Project
VERA Kingdom Community Wind
Lowell Mountain
Lowell, Vermont

Figure No.
1-1

Title
Project Area Risk Assessment Map

1/22/2010

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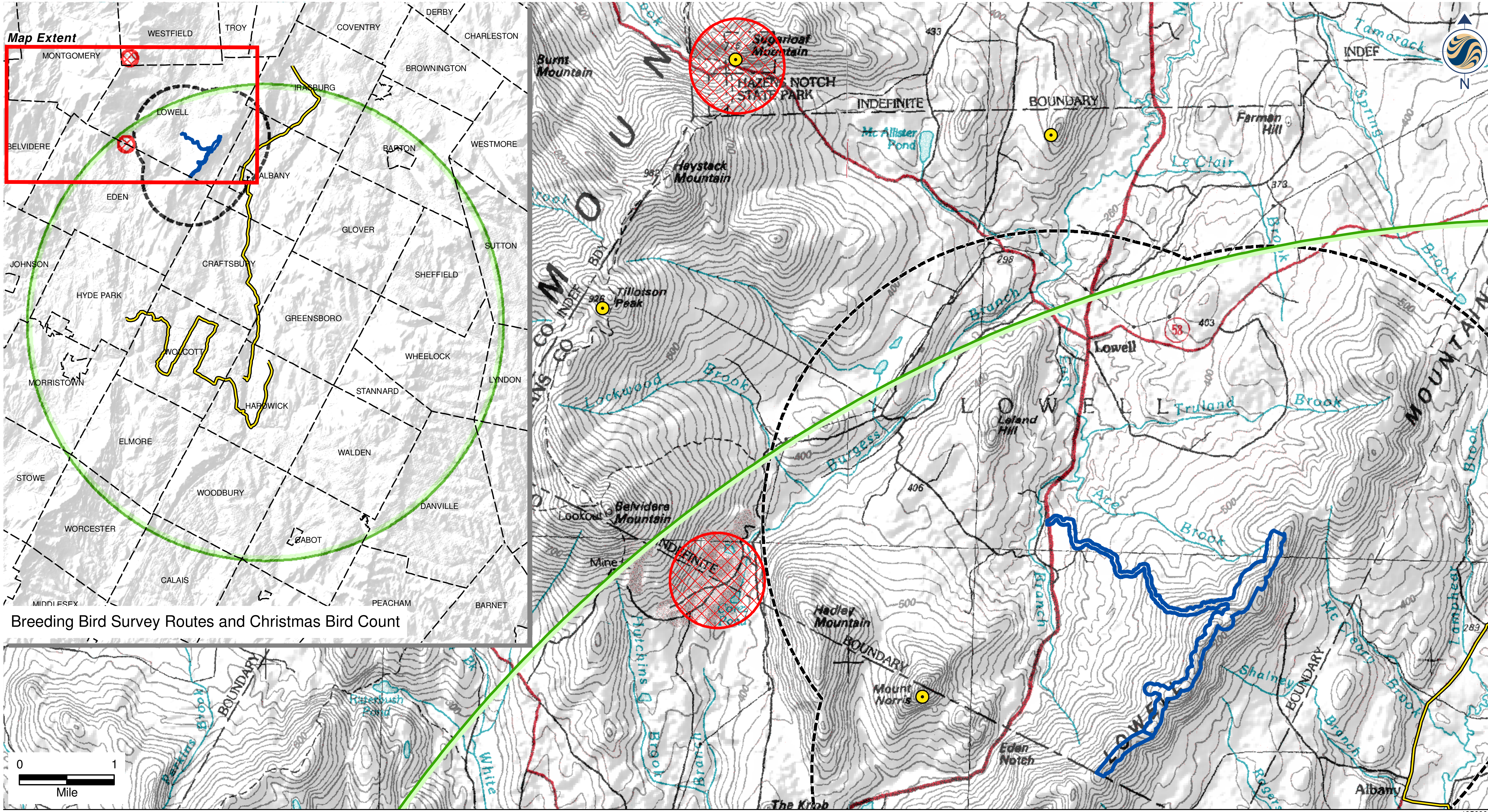

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Legend

- Small-footed Bat Site
- August 2009 Project Area
- Peregrine Falcon Eyre Locations
- Greensboro Christmas Bird Count
- Small-footed Bat Habitat Assessment Area
- Project Area 3 Mile Buffer

Client/Project
VERA Kingdom Community Wind
Lowell Mountain
Lowell, Vermont

Figure No.
1-2

Title
Risk Assessment Map

1/22/2010

Table 2-1. Timing and level of effort for avian and bat field surveys conducted at the Kingdom Community Wind Project

Survey Type	Range of Dates	# Survey Days (or Nights)	# Locations Sampled	Source
Fall 2008 Nocturnal Radar Survey	September 10 - October 13	20	1 radar location	Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont (Stantec 2009a)
Spring 2009 Nocturnal Radar Survey	April 24 - May 29	15	1 radar location	Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont (Stantec 2009a)
Spring 2009 Raptor Migration Survey	April 15 - June 1	10	1 raptor survey location	Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont (Stantec 2009a)
Summer 2009 Breeding Bird Survey	June 10 - June 23	6 (2 pairs of 3 consecutive days)	25 point-count locations	Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont (Stantec 2009a)
2009 Acoustic Bat Survey	April 16 - October 18	856 detector-nights	5 detectors	Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont (Stantec 2009a)
2009 Eastern small-footed bat Habitat Assessment	- -	- -	68.5 miles of roads driven	Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont (Stantec 2009a)

This document serves as an overall synthesis of general survey results at the Project and available information from other publicly available surveys at proposed or existing wind projects in the eastern United States. Detailed descriptions of specific work plans, survey methods and results of surveys included in Table 2-1 are summarized in the corresponding survey report, and are not included in this document.

Although Stantec did not conduct formal habitat surveys as part of its fieldwork, natural community maps produced by VHB, Inc. were reviewed prior to the risk assessment analysis. Fine-scale general information about habitat types present within the Project area was obtained during on-site raptor, radar, breeding bird, and acoustic bat surveys, which involved hiking and/or driving throughout most of the Project area. Throughout this report, “habitat characterizations” refer to information recorded by Stantec during fieldwork in the Project area between 2008 and 2009, and are limited to general, qualitative observations.

2.3 RISK ASSESSMENT

Information gathered for each group (raptors, nocturnally migrating passerines, breeding birds, and bats) during the information review process and on-site field surveys was incorporated into this risk assessment. Although risk assessments used in different fields of study are variable in scope and focus, they often share a common framework with consistent terms used to describe key concepts. Because these terms can be technically complex, the following outlines vocabulary used to describe key components of this risk assessment.

The goal of this document is to assess potential impacts of a wind facility on birds and bats. Birds and bats can either experience direct impacts, in the form of potential collision mortality, or indirect impacts, in the form of potential loss of habitat. In this case, the potential for collision mortality of wildlife (direct impact), or the potential loss of habitat for a species (indirect impact), are each considered an **assessment endpoint:** a "…quantitative or quantifiable expression of the environmental value considered to be at risk…" from a given stressor (Suter 1993). In order to estimate the potential for direct and indirect impacts, various on-site survey methods are used (e.g., nocturnal radar surveys, or acoustic bat surveys), as well as off-site methods such as literature reviews and reviews of regional databases. These methods are each referred to as **measurement endpoints:** the methods used to estimate the effects of exposure on an assessment endpoint. **Weight-of-Evidence (WOE)** is the process by which multiple measurement endpoints are related to an assessment endpoint to evaluate risk. **Potential stressors** evaluated at wind facilities can include moving or stationary turbine blades, monopoles, habitat removal and fragmentation, behavioral effects, or human activity leading to disturbance, among others (Leddy *et al.* 1999). Specific assessment endpoints, measurement endpoints, and stressors for each species category are identified in corresponding subsections of the results section.

A WOE model is a central component of the ERA (ecological risk assessment) that takes into account the strengths and weaknesses of different measurement endpoints. Within this model, lines of evidence that yield high quality, relevant data for a particular ERA are assigned more "weight" than lines of evidence that may be less relevant, or less accurate. This approach is particularly well-suited for an ERA involving multiple measurement endpoints with varying degrees of relevance to particular assessment endpoints, which is typically the case with pre-construction surveys at proposed wind projects. The WOE approach will not eliminate discrepancies in the quality or relatedness of the sources of data, but rather evaluates each source of data in a systematic manner. Professional judgment, along with scientific knowledge and technical expertise, are applied in the evaluation of multiple lines of evidence pertaining to a specific assessment endpoint. The WOE model provides a comprehensive strategy for integrating disparate assessment methods into a cohesive framework that facilitates the interpretation of results.

The procedure used in this risk assessment was modeled after the method developed by the Massachusetts Weight-of-Evidence Workgroup (workgroup), an independent *ad hoc* group of ecological risk assessors from both government and private sectors (Massachusetts Weight-of-Evidence Workgroup 1995). The workgroup drafted a guidance document to provide standardized terminology and methodology for implementing a WOE approach. This document, as well as the United States Environmental Protection Agency's (USEPA) Framework for Ecological Risk Assessment (USEPA 1992), serve as the basis for the approach used to assess risk to bats and birds from the development and operation of the proposed Project. The WOE approach has been used by Stantec to assess risk at the Rollins Wind Project in Maine (Stantec 2009b) and two projects in the Mid-Atlantic (New Creek Mountain [Stantec 2008a] and Laurel

Mountain [Stantec 2008b], West Virginia), where this approach has been accepted by regional regulatory agencies.

The WOE approach followed in this document was organized around four primary processes. First, assessment and measurement endpoints were defined for each species category to best address potential impacts within that category and allow for discussion of risk to certain subgroups separately. Measurement endpoints typically consisted of each type of data available or survey conducted on-site to address a particular assessment endpoint. In some cases, certain similar types of information, such as a variety of types of regional information on abundance of breeding birds, were combined into a single measurement endpoint.

Second, weight was assigned to each measurement endpoint, based on a series of ten criteria considered equally important in evaluating measurement endpoints (Massachusetts Weight-of-Evidence Workgroup 1995). The ten attributes are divided into three categories: 1) strength of association between assessment and measurement endpoints; 2) data quality; and 3) study design and execution (Table 2-2). Each measurement endpoint was scored according to each of the ten attributes, resulting in an overall score of high, medium, or low based on broadly applicable, non-overlapping criteria, as presented in a document prepared by the WOE workgroup (Massachusetts Weight-of Evidence Workgroup 1995). These criteria are identified in Table 2-3. While the criteria contained in Tables 2-2 and 2-3 are more appropriate for use in traditional risk assessments involving stressors present in a system in a measurable quantity, they were applied to the endpoint pairs used in this risk assessment as appropriately and consistently as possible.

Third, each measurement endpoint was evaluated with respect to its indication of risk of harm and the magnitude of this risk. Indication of risk of harm for each measurement/assessment endpoint pair was described as “yes” (potential impact exists), “no” (potential impact does not exist), or “undetermined.” For endpoint pairs where a potential impact was determined to exist, the magnitude of response was characterized has “high,” “moderate,” or “low,” depending on the predicted severity of impact.

Finally, the level of concurrence among measurement endpoints was evaluated to determine whether or not various measurement endpoints generally predicted similar levels and magnitudes of risk. This was done by plotting each measurement endpoint on a matrix, the columns of which present the weights assigned in the first step, and the rows of which present the likelihood of risk based. Agreements or divergences among measurement endpoints are readily observed using this matrix, enabling interpretation of the results of various survey methods with respect to particular assessment endpoints. Within this report, assessment and measurement endpoints are identified and evaluated in the results section, and the remaining steps previously described are contained in the discussion section, organized by the four avian and bat groups in both sections.

Table 2-2. Definitions of attributes used to determine the "weight" of measurement endpoints (Massachusetts Weight-of-Evidence Workgroup 1995)

	Attributes	Measurement Endpoint
I. Strength of Association between Measurement and Assessment Endpoints		
1	Degree of Biological Association	The extent to which the measurement endpoint is representative of, and correlated with, or applicable to the assessment endpoint. Biological linkage is based on known biological processes; similarity of effect, target organism, mechanism of action, and level of ecological organization.
2	Stressor/Response	The ability of the endpoint to demonstrate effect from exposure to the stressor and to correlate effects with the degree of exposure. As such, this attribute also takes into consideration the susceptibility of the receptor and the magnitude of effects observed.
3	Utility of Measure	This attribute relates the ability to judge results of the survey against well-accepted standards, criteria, or objective measures. As such, the attribute describes the applicability, certainty, and scientific basis of the measure, as well as the sensitivity of a benchmark in detecting environmental harm.
II. Data Quality		
4	Data Quality	The degrees to which data quality objectives are designated that are comprehensive and rigorous, as well as the extent to which they are met. Data quality objectives should clearly evaluate the appropriateness of data collection and analysis practices. If any data quality objectives are not met, the reason for not meeting them and the potential impact on the overall assessment should be clearly documented.
III. Study Design and Execution		
5	Site Specificity	The extent to which biological data, environmental conditions, or habitat types used in the measurement endpoint reflect the site of interest.
6	Sensitivity	The ability to detect a response in the measurement endpoint, and the ability to discriminate between responses to a stressor and those resulting from natural or design variability and uncertainty.
7	Spatial Representativeness	The degree of compatibility or overlap between the locations of measurements or samples, locations of stressors, and locations of ecological receptors and their potential exposure.
8	Temporal Representativeness	The degree of temporal overlap between the measurement endpoint (when data were collected) and the period during which effects of concern would be likely to be detected. Also linked to this attribute is the number of measurement or sampling events over time and the expected variability over time.
9	Quantitative Measure	This attribute relates to whether magnitude of response can be assessed objectively or subjectively, and whether the results can be tested for both biological and statistical significance.
10	Standard Method	The extent to which the study follows standard protocols recommended by a recognized scientific authority for conducting the method correctly. Examples of standard methods are study designs repeatedly published in the peer reviewed scientific literature. This attribute also reflects the suitability and applicability of the method to the endpoint and the site, as well as the need for modification of the method.

Table 2-3. Criteria for qualitatively ranking measurement endpoints (Massachusetts Weight-of-Evidence Workgroup 1995)

Attribute		Measurement Endpoint Ranking Criteria		
		LOW	MEDIUM	HIGH
1	**Biological linkage between measurement endpoint and assessment endpoint**	Biological processes link the measurement endpoint to the assessment endpoint only indirectly, yielding a weak correlation between the assessment and measurement endpoints	Measurement and assessment endpoints are directly linked and the adverse effect, target organism, and mechanism of action are the same for both endpoints; however, the levels of ecological organization differ	Assessment endpoint is directly measured and, therefore, is equivalent to the measurement endpoint
2	**Correlation of stressor to response**	Endpoint response to stressor has not been demonstrated in previous studies but is expected based upon demonstrated response to similar stressors	In previous studies, endpoint response to stressor has been demonstrated, but response is not correlated with magnitude of exposure	Statistically significant correlation is demonstrated
3	**Utility of measure for judging environmental harm**	Measure is developed by the investigator (i.e., personal index) and has limited applicability and certainty, the scientific basis is weak, and the benchmark is relatively insensitive	Measure is well accepted and developed by a third party but has either limited applicability or certainty, or the scientific basis is weak, or the benchmark is relatively insensitive	Measure is well accepted and developed by a third party and has very high levels of certainty and applicability, as well as a very strong, scientific basis and benchmark is very sensitive
4	**Quality of data**	Three or more study objectives are not met, the level of error is large, and the data collected is not appropriate to address the assessment endpoint	One study objective is not met, the level of error is moderate, and the data collected is only moderately appropriate to address the assessment endpoint	All study objectives are met, the level of error is low to none, and the data collected appropriately addresses the assessment endpoint
5	**Site Specificity**	Only one or two of the six factors (i.e., data, media, species, environmental conditions, benchmark, habitat type) is derived from or reflects the site	Four of the six factors (i.e., data, media, species, environmental conditions, benchmark, habitat type) are derived from or reflect the site	All six factors (i.e., data, media, species, environmental conditions, benchmark, habitat type) are derived from or reflect the site (i.e., both data and benchmark reflect site conditions)
6	**Sensitivity of the measurement endpoint for detecting changes**	Measurement endpoint can detect only very large and obvious changes in response to stressor	Measurement endpoint can detect moderate level changes in response to stressor	Measurement endpoint is very sensitive and can detect very minute and subtle changes in response to stressor
7	**Spatial representativeness**	The locations of two of the following subjects overlap spatially only to limited extent: study area, sampling/measurement site, stressors, receptors, and points of potential exposure	The locations of three of the following subjects overlap spatially: study area, sampling/measurement site, stressors, receptors, and points of potential exposure	The locations of five of the following subjects overlap spatially: study area, sampling/measurement site, stressors, receptors, and points of potential exposure
8	**Temporal representativeness**	Measurements are collected during a season different from when effects would be expected to be most clearly manifested; AND A single sampling or measurement event is conducted; AND High variability in that parameter is expected over time	Measurements are collected during the same period that effects would be expected to be most clearly manifested; AND A single sampling or measurement event is conducted; AND Moderate variability in that parameter is expected over time	Measurements are collected during the same period that effects would be expected to be most clearly manifested; AND EITHER [two sampling events are conducted and variability is low OR multiple sampling events are conducted and variability is moderate to high]
9	**Quantitativeness**	Results are qualitative and are subject to individual interpretation	Results are quantitative, but data are insufficient to test for statistical significance	Results are quantitative and may be tested for statistical significance; such tests clearly reflect biological significance
10	**Use of a standard method**	Method has never been published AND methodology is not an impact assessment, field survey, toxicity test, benchmark approach, toxicity quotient, or tissue residue analysis	A standard method exists, but its suitability for this purpose is questionable, and it must be modified to be applicable to site specific conditions	A standard method exists and is directly applicable to the measurement endpoint and it was developed precisely for this purpose and requires no modification OR the methodology is used in three or more peer-reviewed studies

3.0 Results

3.1 RAPTORS

3.1.1 Information Review

In addition to the results of on-site field surveys, information regarding the species composition, abundance, and migratory patterns of raptors in the vicinity of the Project area is available from the following data sources (see Appendix A, Tables 1-8):

- Hawk Migration Association of North America (HMANA) data, fall 2009;
- Publicly available pre-construction raptor migration data from wind sites (spring and fall 1996-2008);
- North American US Geological Survey Breeding Bird Survey (USGS BBS) (1999-2009; Figure 1-2);
- Audubon Christmas Bird Count (CBC) (1999-2001; Figure 1-2);
- Known peregrine falcon breeding locations from the USGS Vermont Breeding Bird Atlas (BBA) (2003-2007) and Audubon Peregrine Falcon Eyrie Important Bird Area (IBA) Complex, Hazen's Notch (Figure 1-2);
- Vermont Fish and Wildlife Department (VTFW) Wildlife Action Plan (VTFW 2005); and
- Raptor mortality data from existing wind farms in the United States (outside of California) (1994-2008).

Regional raptor migration data is available from the five HMANA observation points which are in proximity of the Kingdom Community Wind Project and generally share similar landscape features with the Project. These sites include Putney Mountain, Vermont; Little Round Top, Bristol, NH; Pitcher Mountain, Stoddard, NH; Mohonk Preserve, New Paltz, NH; Franklin Mountain, Oneonta, NY; and Summitville, NY. During HMANA surveys, observers scan the airspace visible from the observation location and document the number of individuals and species of migrant raptors seen. Surveys are conducted on multiple survey days throughout spring and fall migration periods; surveys are generally conducted between 9 am to 4 pm. HMANA data in proximity of the Project is only available for the fall and was used to supplement data collected on-site at Kingdom Community during spring 2009. HMANA data provide the species composition of raptors which occur in the region of the Project area during fall migration.

Stantec maintains a database of publicly available raptor migration data from proposed wind sites in region, including results from studies conducted in Maine, Vermont, New York, and West Virginia. Included within this dataset are a summary of the survey effort, the numbers of individuals and species observed, seasonal passage rates, and the percentage of raptors below turbine height for each project. Spring data are available for comparison with the spring 2009 raptor migration data from KCW, and fall data supplement the spring 2009 raptor dataset by providing fall raptor migration information from other proposed wind sites in the region.

The USGS BBS is a national survey conducted annually by volunteers since 1966. The purpose of the surveys is to track the status and trends of North American bird populations. During the annual surveys, volunteers drive and sample designated breeding bird survey routes. Each route is 40 km (24.5 mi) long and includes 50 stops located approximately 0.8 km (0.5 mi) miles apart. At each stop, a three minute point count is conducted. During the count, all birds seen or heard within 0.4 km (0.25 mi) miles are documented. Breeding bird survey routes are conducted at the peak of the breeding period for most bird species, typically in June, depending on the region. USGS BBS data are available for Hardwick and Greensboro, VT, the two routes in closest proximity to KCW, from 1999 to 2009 (Appendix A, Table 1 and Table 2). These routes pass at their closest point to within two and nine miles of the Project, respectively (Figure 1-2). Habitats on both routes include mature northern hardwood forests and agricultural grasslands of various management classes. The USGS BBS data provide a composition of raptor species and other birds that breed in the vicinity of the Project and region, as well as the relative abundance of these species along survey routes.

The Audubon CBC was developed to monitor the status and distribution of birds in the Western Hemisphere. The CBC occurs during early winter each year, typically from December 14 to January 5. Each year a series of designated count circles, with 24 km (15 mi) diameters, are surveyed by approximately 10 observers over a period of 24 hours. All birds detected within the count circle are recorded. The nearest CBC location to the Project is Craftsbury-Greensboro (VTCG), approximately 11 mi southeast of the Project, and includes all of the Project area within its boundary (Figure 1-2; Appendix A, Table 3). CBC data provides the species composition and relative abundance of raptors and other birds which occur in broad regional areas during winter.

Vermont is among the states that participate in the USGS BBA, which is a bird population survey project that was designed to monitor the distribution of breeding birds across a large geographic area. Each survey block within participating states consists of one-sixth of a USGS 7.5 minute topographic quad. During the breeding season, surveyors conduct area searches throughout each survey block. The surveyors document all evidence of breeding birds as confirmed, probable, or possible. The data is mapped and provides distribution data by breeding bird species. Based on results from BBA surveys from 2003 to 2007, there are two blocks within 8 mi of the Project with confirmed breeding peregrine falcons, and one block with possible breeding peregrine falcon within 10 mi of the Project. The two locations with confirmed breeding peregrine falcons are located at Hazen’s Notch, Westfield, VT, and the Belvidere Mountain Quarry, Lowell, VT (Figure 1-2; Fowle 2007). These locations are part of a number of peaks included in the Audubon Peregrine Falcon Eyrie IBA complex. An Audubon IBA is a site that provides essential habitat to threatened or endangered species, species with restricted ranges or habitats, or species that congregate a large portion of their population in one location.

The Vermont Wildlife Action Plan includes a list of the species in Vermont considered of greatest conservation need. For raptor and other avian species of high priority and medium priority conservation concern, the Wildlife Action Plan provides information pertaining to the conservation assessment, known distribution, habitat description, current conservation problems, and research and monitoring needs.

Also available are the results of 25 post-construction mortality studies conducted at 20 different locations throughout the U.S. (outside of California) (Osborn *et al.* 2000, Johnson *et al*. 2002, Kerlinger 2002, Young *et al.* 2003, Erickson *et al.* 2000, Erickson *et al.* 2004, Kerlinger 2006, Erickson *et al.* 2003, Johnson *et al*. 2003, Kerns and Kerlinger 2004, Arnett *et al.* 2005, Koford *et al*. 2005, Fiedler *et al*. 2007, Howe *et al.* 2002, Jain *et al*. 2007, Jain *et al*. 2008, Jain *et al.* 2009a, Stantec 2008c, Stantec 2009b, Young *et al*. 2009, Tidhar 2009a, Jain *et al.* 2009b, Jain *et al.* 2009c, Jain *et al.* 2009d). These studies provide information regarding the numbers of individuals and species of raptors that have been involved with collisions at wind farms across the U.S. (Appendix A, Table 4).

3.1.2 Field Surveys

On-site field surveys to document raptor migration activity in the Project area occurred on 10 days during the spring migration season in 2009 (Table 2-1). Raptor migration surveys were conducted from a central and prominent observation location overlooking the Project area. Detailed descriptions of the methods and results of the raptor survey are available in the Bird and Bat Survey Report (Stantec 2009a).

3.1.3 Risk Assessment Endpoints

Two assessment endpoints were chosen for the evaluation of risk to raptors associated with the Project: (1) potential collision mortality of raptors, including resident and migrating individuals, and (2) potential habitat loss or displacement of raptors from the Project area. Four measurement endpoints were identified for these assessment endpoints as specified in Table 3-1. Measurement endpoints consisted of literature review (1a and 2a), results of the on-site raptor spring migration surveys and regional bird surveys (1b), and results of a general habitat characterization (2b). Literature review included a review of information on interactions between raptors and wind turbines, collision mortality data from operational wind projects, and information on the distribution of raptors (including Rare, Threatened and Endangered [RTE] species) in the vicinity of the Project area.

Table 3-1. Assessment and measurement endpoints used to assess risk to raptors at Kingdom Community Wind Project

Assessment Endpoint		Measurement Endpoints		Measurement Endpoint Response
1	Potential collision mortality of resident and migratory raptors	1a	Literature review	Species composition, abundance, and flight patterns of raptors in the project area and region. Literature review regarding interactions between raptors and turbines and collision mortality results from other sites.
		1b	On-Site Spring Raptor Migration Surveys, Regional Bird Surveys	
2	Potential habitat loss or displacement of raptors from the project area	2a	Literature review	Characterize available habitat pre-construction, and the types of habitat loss/conversion and bird displacement resulting from construction and operation.
		2b	Habitat Characterization	

Each measurement/assessment endpoint pair was assigned a weight based on the attributes and criteria described in the methods section. Overall, the measurement endpoints were evaluated as low/medium to medium/high weight-of-evidence (Table 3-2). Pre-construction raptor surveys provide documentation on species present, including RTE species, at the Project area. Presumably, risk of direct and indirect impacts is associated with exposure to the stressor (the wind facility). Depending on behavior, species documented at the Project area pre-construction could be exposed to the stressor once it is constructed, or could avoid the stressor and thus avoid exposure to risk. Literature review provides information on how raptors may behave once the stressor is present in the landscape. However, there is still uncertainty when using pre-construction surveys and literature reviews to assign a level of risk to this group, because the influence of site location and the factors resulting in collision or displacement are not fully understood. This uncertainty is reflected in the wide range of measurement endpoint scores. It is important to note that additional pre-construction surveys would not necessarily increase the rankings of these attributes or the ability to accurately predict risk to raptors, specifically because additional field survey data would not further explain the link between pre-construction and post-construction conditions.

Table 3-2. Weight-of-evidence evaluation of measurement endpoints used to evaluate risk to raptors at the Kingdom Community Wind Project

Attributes	Measurement Endpoints				Rationale
	Collision mortality		Indirect Impacts		
	1a	1b	2a	2b	
	Literature Review	Raptor Migration Surveys and Regional Bird Surveys	Literature Review	Habitat Characterization	
II. Strength of Association between Assessment and Measurement Endpoint					
Degree of Biological Association	Medium	Medium	Medium	Medium	Literature review can directly characterize patterns in collision mortality and indirect displacement at existing wind farms only. Pre-construction raptor surveys can document species composition and behavior of raptors, although these results can only be used indirectly to characterize risk of collision or indirect impacts, as relationships between pre-construction surveys and post-construction surveys have not been established.
Stressor/Response	Medium	Medium	Medium	Medium	Increased exposure to wind turbines presumably increases risk of collision, although the mechanisms explaining collision mortality remain ambiguous. However, patterns in collision mortality, raptor avoidance capabilities, and indirect impacts will likely be similar between sites, so as more information is gathered, this relationship will become stronger, for at least some species.
Utility of Measure	Medium	Medium	Medium	Medium	The methods used for raptor migration surveys and habitat surveys (and the literature that reports their results) are well accepted and developed by a third party, but they have limited applicability and are relatively insensitive for determining risk.
II. Data Quality					
Data Quality	Medium	Medium	Medium	Medium	Raptor surveys are appropriate tools to characterize raptor activity in the Project area. Although surveys were conducted in a rigorous manner, results of these types of ecological surveys are inherently subject to uncertainty and require extrapolation to relate to the assessment endpoints.
III. Study Design					
Site Specificity	Low	High	Low	High	Raptor migration and habitat surveys provide highly site-specific data that could provide means for comparison of pre- and post-construction results. Literature review of mortality surveys at other sites has uncertain applicability to the exposure site. Habitat characterizations directly measure loss/conversion at the site of interest and lit review of habitat loss at other areas is probably moderately applicable.
Sensitivity	Low	High	Low	Medium	Raptor and regional bird surveys can detect subtle changes in the species composition, relative abundance, and behavior of raptors in the Project area provided that surveys are conducted on a regular basis using the same methods. Habitat characterizations can detect moderate level changes in raptor habitat from measuring loss/conversion.
Spatial Representativeness	Low	High	Low	Medium	Raptor surveys were conducted from a central and prominent location in the Project area. Habitat characterizations were general, focusing on dominant conditions and major losses/conversions expected.
Temporal Representativeness	N/A	High	N/A	Medium	On-site raptor surveys took place during the spring migration periods, and occurred throughout most of the migration period. Regional bird surveys provide information during the breeding season, spring and fall migration, as well as during the winter.
Quantitative Measure	Low	Medium	Medium	Low	The magnitude of response to the stressor can not be tested statistically for pre-construction raptor surveys, because the exposure has not yet occurred. Statistical tests, such as those used in spatial statistics in GIS analysis of fragmentation or connectivity, could be conducted and applied to a predictive model of impact to raptor habitat.
Standard Method	N/A	High	N/A	Medium	A standard method exists for conducting raptor migration surveys and other regional bird surveys; however, applicability to predicting risk is questionable. Methods for habitat characterizations are well documented and application to evaluating loss/conversion of bat habitat could be standardized.
Overall Endpoint Value*	Low/Medium	Medium/High	Low/Medium	Medium	* Overall endpoint value was determined by determining the number of attributes ranked as “low”, “medium”, and “high” for each measurement endpoint.

3.2 NOCTURNALLY MIGRATING PASSERINES

3.2.1 Information Review

Nocturnal migrants consist primarily of migrating passerines. Although various species of migratory bats also migrate at night, potential impacts to migratory bats are discussed separately in sections 3.4 and 4.4. Little information is available on regional patterns, numbers, and species composition of nocturnally migrating passerines. However, general literature exists on behavior of migrating birds with respect to topography, seasonal timing, and general migration routes. More specific information is available on energetic requirements, physiology, and genetic characterization, but this body of literature is not directly relevant to assessing risk to migrating songbirds. Also, an increasing amount of information from radar surveys conducted at proposed wind projects is becoming publicly available and provides general information on flight heights and passage rates on a somewhat more specific level. Several entities have conducted numerous radar surveys at proposed wind projects throughout the east between 2004 and 2009 (Appendix A, Table 8 in Stantec 2009a). Results of these surveys were compared to those from the Project area to provide context, and to characterize overall anticipated migration patterns in the vicinity of the Project.

Also available are the results of 25 post-construction mortality studies conducted at 20 different operational wind projects throughout the U.S. (outside of California) (Osborn *et al.* 2000, Johnson *et al*. 2002, Kerlinger 2002, Young *et al.* 2003, Erickson *et al.* 2000, Erickson *et al.* 2004, Kerlinger 2006, Erickson *et al.* 2003, Johnson *et al*. 2003, Kerns and Kerlinger 2004, Arnett *et al* 2005, Koford *et al*. 2005, Fiedler *et al*. 2007, Howe *et al.* 2002, Jain *et al*. 2007, Jain *et al*. 2008, Jain *et al.* 2009a, Stantec 2008c, Stantec 2009b, Young *et al*. 2009, Tidhar 2009a, Jain *et al.* 2009b, Jain *et al.* 2009c, Jain *et al.* 2009d). These studies provide information regarding the numbers of individuals and species of nocturnally migrating passerines that have been involved with collisions at wind farms (Appendix A, Table 4).

3.2.2 Field Surveys

Nocturnal marine radar surveys were conducted in the Project area during fall 2008 and spring 2009 from a clearing near the high point of Lowell Mountain (Figure 1-1). At this location, the radar had relatively unobstructed views of the surrounding airspace within the radar's range of detection, except for a small portion of ground clutter caused by a slight increase in elevation to the northwest and the tree line to the southeast. During the fall 2008 survey, 20 nights were surveyed between September 1 and October 15, 2008 and during the spring 2009 survey, 15 nights were surveyed between April 15 and June 1, 2009. An X-band, 12 kilowatt (kW) marine radar unit mounted on an 8 m fixed platform was used in the same location for both surveys, which were conducted using the same methodology. Mean hourly and nightly passage rates, flight direction, and flight heights were determined for the duration of each survey. Detailed summaries of survey methods and results are included in Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont (Stantec 2009a).

3.2.3 Risk Assessment

A single assessment endpoint was chosen for the evaluation of risk to nocturnally migrating passerines associated with the Project: potential collision mortality of nocturnally migrating passerines. Potential indirect impacts to nocturnally migrating passerines, such as loss of stopover habitat, are discussed under indirect impacts to breeding birds. Because sufficient data do not exist to characterize patterns of nocturnal migration within the Project area on a species-specific or even guild-specific level, risk is discussed for nocturnal migrants as a group. Two measurement endpoints were identified as specified in Table 3-3. Measurement endpoints consisted of literature review (3a) and results of fall 2008 and spring 2009 nocturnal radar surveys (3b). Literature review included a review of information on interactions between nocturnally migrating passerines and wind turbines, collision mortality data from operational wind projects (including the few in New England), and information on general migration patterns in the vicinity of the Project area.

Table 3-3. Assessment and measurement endpoints used to assess risk to nocturnally migrating passerines at the Kingdom Community Wind Project

<table>
<tr><th colspan="2">Assessment Endpoint</th><th colspan="2">Measurement Endpoints</th><th>Measurement Endpoint Response</th></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Potential collision mortality of nocturnally migrating passerines</td><td>3a</td><td>Literature Review</td><td rowspan="2">Review literature regarding interactions between nocturnal migrants and turbines and collision mortality results from other sites. Document flight patterns of nocturnal migrants above the Project area during spring and fall migration periods.</td></tr>
<tr><td>3b</td><td>On-site Radar Surveys</td></tr>
</table>

Each measurement/assessment endpoint pair was assigned a weight based on the attributes and criteria described in the methods section. Overall, the measurement endpoints were evaluated as low/medium to medium weight-of-evidence (Table 3-4). Pre-construction radar surveys provided a thorough characterization of nocturnal migration activity in the Project area. Presumably, risk of direct and indirect impacts is associated with exposure to the stressor (the wind facility). Depending on behavior, activity documented at the Project area pre-construction could indicate exposure to the stressor once it is constructed; although individuals could avoid the stressor and thus avoid exposure to risk. Literature review provides information on how nocturnally migrating passerines may behave once the stressor is present in the landscape, as well as information on pre-construction survey results at regional planned and constructed facilities. However, there is still uncertainty when using pre-construction surveys and literature reviews to assign a level of risk to this group, because the influence of site location and the factors resulting in collision are not fully understood. This uncertainty is reflected in the relatively low scoring of measurement endpoints. It is important to note that additional pre-construction surveys would not necessarily increase the rankings of these attributes or the ability to accurately predict risk to nocturnally migrating passerines, specifically because additional field survey data would not further detail the link between pre-construction and post-construction conditions.

Table 3-4. Weight-of-evidence evaluation of measurement endpoints used to evaluate risk to nocturnal migrants at the Kingdom Community Wind Project

Attributes	Measurement Endpoints – Collision mortality: 3a Literature Review	Measurement Endpoints – Collision mortality: 3b Spring and Fall Radar Surveys	Rationale
II. Strength of Association between Assessment and Measurement Endpoint			
Degree of Biological Association	Medium	Medium	Pre-construction radar surveys can document flight patterns and passage rates of nocturnal migrants through the Project area, although these results can only be used indirectly to characterize risk of collision or indirect impacts, as relationships between pre-construction surveys and post-construction surveys have not been established. Literature review can directly characterize patterns in collision mortality and indirect displacement at existing wind farms only.
Stressor/Response	Medium	Medium	Increased exposure to wind turbines presumably increases risk of collision, although the mechanisms explaining collision mortality remain ambiguous. However, patterns in collision mortality, avoidance behavior, and indirect impacts will likely be similar between sites, so as more information is gathered, this relationship is expected to become stronger.
Utility of Measure	Medium	Medium	The methods used for radar surveys and habitat characterizations (and the literature that reports their results) are well accepted and developed by a third party, but they have limited applicability and are relatively insensitive for determining risk.
II. Data Quality			
Data Quality	High	High	Radar surveys provide an appropriate means to characterize migration patterns of nocturnal migrants in the Project area, and surveys were conducted in a rigorous manner. However, results of these types of ecological surveys are inherently subject to uncertainty and require extrapolation to relate to the assessment endpoints.
III. Study Design			
Site Specificity	Low	High	Radar and habitat characterizations provide highly site-specific data that could provide means for comparison of pre- and post-construction results. Literature review of mortality surveys at other sites has uncertain applicability to the exposure site. Habitat characterizations directly measure loss/conversion at the site of interest and literature review of habitat loss at other areas is probably moderately applicable.
Sensitivity	Low	High	Radar surveys can detect relatively subtle changes in the flight patterns and passage rates of nocturnal migrants, which could be used to assess effects of wind turbines on migration provided that pre- and post-construction surveys were conducted in a suitable manner.
Spatial Representativeness	Low	Medium	Although radar surveys were conducted from only one site in the Project area, a general understanding of patterns in migration of nocturnal migrants suggests that patterns would be relatively uniform throughout the Project area. Habitat characterizations were general, focusing on dominant conditions and major losses/conversions expected.
Temporal Representativeness	N/A	High	Radar surveys took place during a representative sample of the spring and fall migration periods, accurately characterizing the range of migration activity.
Quantitative Measure	Low	Low	The magnitude of response to the stressor can not be tested statistically for pre-construction radar surveys, because the exposure has not yet occurred. Statistical tests, such as those used in spatial statistics in GIS analysis of fragmentation or connectivity, could be conducted and applied to a predictive model of impact to habitat for nocturnal migrants.
Standard Method	N/A	Medium	A standard method exists for conducting radar migration surveys, but its applicability to predicting risk is questionable. Methods for habitat characterizations are well documented and application to evaluating loss/conversion of bat habitat could be standardized.
Overall Endpoint Value*	Low/Medium	Medium	* Overall endpoint value was determined by determining the number of attributes ranked as “low”, “medium”, and “high” for each measurement endpoint.

3.3 BREEDING BIRDS

3.3.1 Information Review

A variety of sources of data exists on the distribution and abundance of breeding birds in the vicinity of the Project and are described below. These sources include:

- USGS Breeding Bird Survey (1999-2009; Figure 1-2);
- Audubon Christmas Bird Count (1999-2009; Figure 1-2);
- Cornell Lab of Ornithology and National Audubon Society eBird Online Checklist (2010);
- Vermont Fish and Wildlife Department (VTFWD) Non-game and Natural Heritage Program Bird Species List and Vermont Wildlife Action Plan (WAP); and
- Life history behavioral information (Birds of North America Online [BNA]).

In addition to the survey types described previously in section 3.1.1 (USGS BBS and Audubon CBC), breeding bird information was collected from eBird (http://ebird.org/content/ebird/about). The Cornell Bird Laboratory and the National Audubon Society maintain an online checklist tool known as eBird to store avian abundance and distribution data collected by amateur and professional bird watchers across the country. Data submissions are available in real-time as they are submitted and can be accessed in many different forms including by species, region, high counts, and arrival/departure dates. For the purposes of comparison, 2009 data from Orleans County was downloaded for the period between January 1 and December 31. Whereas CBC, BBS, and BBA surveys are season-specific, the data submitted to eBird is annual, and often includes migrant or incidental species that may be seasonally abundant but not documented with other survey types.

For certain species within the Project area, natural history information was obtained to help assess potential levels of direct and indirect risk associated with the Project. These data were obtained from a variety of sources, including literature reported in the Birds of North America Online (2010) and other species-specific literature, and are included in relevant sections of the discussion. The above sources of data were used, in combination with results of field surveys, to characterize the overall breeding bird population within the Project area and immediate vicinity.

3.3.2 Field Surveys

Field surveys for breeding birds within the Project area consisted of two rounds of BBS point counts during June 2009. These surveys consisted of 17 10-minute point counts located in direct impact areas and in the vicinity of turbines or roads, and an additional 8 10-minute control points located on the Project area periphery. Control points were established in habitats representative to the Project area in order to assess any year-to-year changes not directly attributable to the wind facility construction. Each survey location was sampled during two survey periods, one in mid-June (June 10 and 12) and one in late June (June 21 and 23) (Figure 1-1). After each count at all 25 survey locations, playback surveys for Bicknell's thrush were conducted using a previously recorded Bicknell's thrush call played from a small speaker.

On-site BBS also included documentation of incidental observations made outside of the official point count periods but during on-site visits. A detailed summary of the methods and results of these surveys can be found in Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont (Stantec 2009a), along with the complete list of species detected in the Project area during the BBS (Appendix A, Tables 1 through 6 in Stantec 2009a). In addition to on-site BBS, habitat surveys were conducted periodically between spring and fall, 2009. These included overall documentation of the types and relative amounts of breeding bird habitat within the Project area. Habitat characterizations, consisting of qualitative notes made during on-site field surveys, also contributed to the risk assessment.

3.3.3 Risk Assessment Endpoints

Two assessment endpoints were chosen for the evaluation of risk to breeding birds associated with the Project: potential collision mortality of breeding birds (assessment endpoint 4), and potential indirect impacts (habitat loss, displacement) to breeding birds (assessment endpoint 5). When possible, potential impacts to individual species or guilds are discussed for each assessment endpoint. Measurement endpoints were identified for each assessment endpoint as specified in Table 3-5. Measurement endpoints consisted of results of literature review (4a and 5a), on-site and regional breeding bird surveys (4b), and habitat characterizations (5b). Literature review included a review of information on interactions between breeding birds and wind turbines, collision mortality data from operational wind projects, and information regarding potential effects of habitat loss and habitat conversion on breeding birds.

Table 3-5. Assessment and measurement endpoints used to assess risk to breeding birds at the Kingdom Community Wind Project

Assessment Endpoint		Measurement Endpoints		Measurement Endpoint Response
4	Potential collision mortality of breeding birds	4a	Literature Review	Review literature regarding interactions between breeding birds and turbines and collision mortality results from other sites. Document species diversity, relative abundance, and distribution of breeding birds in the Project area.
		4b	On-site and Regional Bird Surveys	
5	Potential indirect impacts to breeding birds	5a	Literature Review	Determine how habitat loss/conversion may impact breeding bird abundance and distribution in the Project area.
		5b	Habitat Characterization	

Each measurement/assessment endpoint pair was assigned a weight based on the attributes and criteria described in the methods section. Overall, the measurement endpoints were evaluated as low/medium to medium/high weight-of-evidence (Table 3-6). Pre-construction breeding bird surveys provide documentation on species present, including RTE species or their habitats, at the Project area. Presumably, risk of direct and indirect impacts is associated with exposure to the stressor (the wind facility). Depending on behavior, species documented at the

Project area pre-construction could be exposed to the stressor once it is constructed, or could avoid the stressor and thus avoid exposure to risk. Furthermore, exposure to the stressor could displace some species, but may not result in impacts for other species. Literature review provides information on how different species of breeding birds may behave once the stressor is present in the landscape. However, there is still uncertainty when using pre-construction surveys and literature reviews to assign a level of risk to this group, because the influence of site location and the factors resulting in collision or displacement are not fully understood. This uncertainty is reflected in the wide range of measurement endpoint scores. It is important to note that additional pre-construction surveys would not necessarily increase the rankings of these attributes or the ability to accurately predict risk to breeding birds, specifically because additional field survey data would not further understanding of the link between pre-construction and post-construction conditions.

Table 3-6. Weight-of-evidence evaluation of measurement endpoints used to evaluate risk to breeding birds at the Kingdom Community Wind Project

Attributes	Measurement Endpoints				Rationale
	Collision Mortality		Indirect Impacts		
	4a Literature Review	4b On-site and Regional Bird Surveys	5a Literature Review	5b Habitat Characterization	
I. Strength of Association between Assessment and Measurement Endpoint					
Degree of Biological Association	Medium	Medium	Medium	Medium	Literature review can directly characterize patterns in collision mortality and indirect displacement at existing wind farms only. Pre-construction breeding bird surveys can document species composition and relative abundance of breeding birds in the Project area, although these results can only be used indirectly to characterize potential risk of collision or indirect impacts, as relationships between pre-construction surveys and post-construction surveys have not been established.
Stressor/Response	Medium	Medium	Medium	Medium	Increased exposure to wind turbines presumably increases risk of collision, although the mechanisms explaining collision mortality remain ambiguous. However, patterns in collision mortality and indirect impacts will likely be similar between sites, so as more information is gathered, this relationship is expected to become stronger.
Utility of Measure	Medium	Medium	Medium	Medium	The methods used for breeding bird surveys and habitat characterizations (and the literature that reports their results) are well accepted and developed by a third party, but have limited applicability and are relatively insensitive for determining risk.
II. Data Quality					
Data Quality	High	High	High	High	Breeding bird surveys provide an appropriate means to characterize the breeding bird population in the Project area, and surveys were conducted in a rigorous manner. However, results of these types of ecological surveys are inherently subject to uncertainty and require extrapolation to relate to the assessment endpoints.
III. Study Design					
Site Specificity	Low	High	Medium	High	Literature review of mortality surveys at other sites has uncertain applicability to the exposure site. Breeding bird and habitat characterizations provide highly site-specific data that could provide means for comparison of pre- and post-construction results. Habitat characterizations directly measure loss/conversion at the site of interest and literature review of habitat loss at other areas is probably moderately applicable.
Sensitivity	Low	High	Low	Medium	Breeding bird surveys can detect changes in species composition and abundance of breeding birds over time, which could be used to assess indirect impacts of the wind Project provided that pre- and post-construction surveys were conducted in a suitable manner. Habitat assessments can detect moderate level changes in breeding bird habitat from measuring loss/conversion.
Spatial Representativeness	Low	High	Low	Medium	Breeding bird surveys were conducted throughout the Project area in a variety of representative habitats. Habitat characterizations were general, focusing on dominant conditions and major losses/conversions expected.
Temporal Representativeness	N/A	High	N/A	N/A	On-site field surveys took place at two time periods during the active breeding season of birds. Regional surveys include data from multiple years of surveys.
Quantitative Measure	Low	Low	Medium	Low	The magnitude of response to the stressor can not be tested statistically for pre-construction breeding bird surveys, because the exposure has not yet occurred. Statistical tests, such as those used in spatial statistics in GIS analysis of fragmentation or connectivity, could be conducted and applied to a predictive model of impact to habitat for nocturnal migrants.
Standard Method	N/A	Medium	N/A	Medium	A standard method exists for conducting breeding bird surveys, but its applicability to predicting risk is questionable. Methods for habitat characterizations are well documented and application to evaluating loss/conversion of bat habitat could be standardized.
Overall Endpoint Value*	Low/Medium	Medium/High	Medium	Medium	* Overall endpoint value was determined by determining the number of attributes ranked as "low", "medium", and "high" for each measurement endpoint.

3.4 BATS

3.4.1 Information Review

Sources of information relating to the abundance and distribution of bats in the Northeast, including Vermont, are limited. Stantec reviewed literature on the overall distribution of species in the east, with the understanding that these types of data are rarely specific enough to draw conclusions on a site-specific basis. Literature review also included a review of information on interactions between bats and wind turbines, collision mortality data from operational wind projects, information on the distribution of bat species (including RTE species) in the vicinity of the Project area, and information regarding the effects of habitat loss and conversion on bats. Qualitative habitat information gathered during field surveys in the Project area, such as landscape cover, forest structure, distribution of water sources, and topography was used to characterize the overall suitability of the Project area for bats.

3.4.2 Field Surveys

On-site field surveys for bats in the Project area consisted of one season of acoustic monitoring, lasting from April 2009 to October 2009 (Table 2-1). A total of five detectors were used during the acoustic survey: 2 detectors mounted at ground-level, 2 detectors mounted in temporary towers, and 1 detector mounted at tree-canopy height at the top of a dead tree (Figure 1-1). A detailed description of the survey design, methods, and results of this survey is included in Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont (Stantec 2009a).

In addition to the on-site acoustic survey, a remote desktop survey was conducted to identify areas with slopes greater than 30 degrees, southerly aspects, and visible rock formations, which would indicate potential eastern small-footed bat roost habitat. This remote survey was followed by a site visit to look for potential roost habitat not identified using remote means. A detailed description of the survey design, methods, and results of this survey is included in Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont (Stantec 2009a).

3.4.3 Risk Assessment Endpoints

Two assessment endpoints were chosen for the evaluation of risk to bats associated with the Project: potential collision mortality of bats (assessment endpoint 6); and potential loss of habitat or displacement (assessment endpoint 7). These endpoints were chosen so as to separately evaluate direct risk of collision mortality to bat species in the area and indirect habitat loss associated with the Project. Measurement endpoints were identified for each assessment endpoint as specified in Table 3-17. Measurement endpoints consisted of results of literature review (6a, 7a), on-site acoustic bat surveys (6b), a general habitat assessment (7b), and an assessment of potential eastern small-footed bat habitat (7c).

Table 3-7. Assessment and measurement endpoints used to assess risk to bats at the Kingdom Community Wind Project

Assessment Endpoint		Measurement Endpoints		Measurement Endpoint Response
6	Potential collision mortality of bats	6a	Literature Review	Measure species composition and relative abundance, and determine activity patterns of bats in the Project area. Relate these to known patterns of collision mortality from operational sites.
		6b	Acoustic Bat Surveys	
7	Potential habitat loss or displacement of bats from the Project area	7a	Literature Review	Document available habitat pre-construction, and potential effects of habitat loss.
		7b	Habitat Characterization	
		7c	Eastern small-footed bat habitat assessment	

Each measurement/assessment endpoint pair was assigned a weight based on the attributes and criteria described in the methods section. Overall, the measurement endpoints were evaluated as low/medium to medium weight-of-evidence (Table 3-8). Pre-construction acoustic surveys provided a thorough characterization of bat activity and general species composition in the Project area. Presumably, risk of direct and indirect impacts is associated with exposure to the stressor (the wind facility). Depending on behavior, activity documented at the Project area pre-construction could indicate exposure to the stressor once it is constructed; although some species could avoid the stressor and thus avoid exposure to risk. Literature review provides information on how different bat species may behave once the stressor is present in the landscape, as well as information on pre-construction survey results at regional planned and constructed facilities. However, there is still uncertainty when using pre-construction surveys and literature reviews to assign a level of risk to this group, because the influence of site location and the factors resulting in collision are not fully understood. This uncertainty is reflected in the relatively low scoring of measurement endpoints. It is important to note that additional pre-construction surveys would not necessarily increase the rankings of these attributes or the ability to accurately predict risk to bats, specifically because additional field survey data would not further any understanding of the link between pre-construction and post-construction conditions.

Table 3-8. Weight-of-evidence evaluation of measurement endpoints used to evaluate risk to bats at the Kingdom Community Wind Project

Attributes	Measurement Endpoints					Rationale
	Collision Mortality		Indirect Impacts			
	6a Literature Review	6b Acoustic Bat Survey	7a Literature Review	7b Habitat Characterization	7c Small-footed bat habitat assessment	
I. Strength of Association between Assessment and Measurement Endpoint						
Degree of Biological Association	Medium	Low	Medium	Medium	Medium	Literature review can directly characterize patterns in collision mortality and indirect displacement at existing wind farms only. Pre-construction acoustic surveys can document species composition and bat activity patterns, although these results can only be used indirectly to characterize risk of collision or indirect impacts, as relationships between pre-construction surveys and post-construction surveys have not been established. Small-footed bat assessments do not document presence directly, and apply only to one species found in the area, but serve to determine if additional surveys to document presence or absence are necessary.
Stressor/Response	Medium	Low	Medium	Medium	Medium	Increased exposure to wind turbines presumably increases risk of collision, although the mechanisms explaining collision mortality remain ambiguous. Patterns in collision mortality and indirect impacts will likely be similar between sites, so as more information is gathered, this relationship will become stronger, for at least some species.
Utility of Measure	Medium	Medium	Medium	Medium	Medium	The methods used for acoustic bat surveys and habitat assessments (and the literature that reports their results) are well accepted and developed by a third party, but they have limited applicability and are relatively insensitive for determining risk.
II. Data Quality						
Data Quality	Medium	Medium	Medium	Medium	Low	The objectives of documenting activity patterns of bats were met by acoustic surveys. The objective of identifying potential small-footed bat habitat may have been met at large scales by the habitat assessment, but data is weak at small scales and error could be large. Results of these types of ecological surveys are inherently subject to variation and require extrapolation to relate to the assessment endpoints.
III. Study Design						
Site Specificity	Low	High	Medium	Medium	Medium	Acoustic surveys provide site-specific data that could provide means for comparison of pre- and post-construction results. Literature review of post-construction mortality surveys at other sites has uncertain applicability to the exposure site. Habitat characterizations directly address potential loss/conversion at the site of interest and literature review of habitat loss at other areas is probably moderately applicable, although extrapolation is required to relate to indirect impacts.
Sensitivity	Low	Low	Low	Medium	Low	Acoustic surveys can detect slight changes in activity levels, although these changes would not necessarily be correlated to the stressor. Habitat characterizations can detect moderate level changes in bat habitat from measuring loss/conversion.
Spatial Representativeness	Low	Medium	Low	Medium	Medium	Acoustic surveys were conducted at three locations and two heights, but did not survey into the rotor-swept zone. Habitat characterizations were general, focusing on dominant conditions and major losses/conversions expected.
Temporal Representativeness	N/A	Medium	N/A	N/A	N/A	Acoustic surveys sampled the entire non-hibernation period, including the fall migration period in which bat mortality is expected to be highest; however, year-to-year variation was not sampled.
Quantitative Measure	Low	Low	Low	Medium	Medium	The magnitude of response to the stressor can not be tested statistically for acoustic surveys, because the exposure has not yet occurred. Statistical tests, such as those used in spatial statistics in GIS analysis of fragmentation or connectivity, could be conducted and applied to a predictive model of impact to bat habitat.
Standard Method	N/A	High	N/A	Medium	Medium	Fairly standardized methods exist for acoustic surveys, but they are only moderately applicable to assessing exposure. Methods for habitat characterizations are well documented and application to evaluating loss/conversion of bat habitat could be standardized.
Overall Endpoint Value*	Low/Medium	Low/Medium	Low/Medium	Medium	Medium	* Overall endpoint value was determined by determining the number of attributes ranked as “low”, “medium”, and “high” for each measurement endpoint.

4.0 Discussion

4.1 RAPTORS

4.1.1 Raptor Collision Mortality (Assessment Endpoint 1)

4.1.1.1 Literature Review (Measurement Endpoint 1a)

Regional Migration Patterns

In the eastern U.S., migrating raptors tend to concentrate along the shorelines of major bodies of water (including the Atlantic Coast, as most species of raptor avoid crossing large expanses of water [Kellogg 2007]). Migration activity is also notable along linear ridges, along which atmospheric conditions create deflective updrafts or “thermals” that raptors can use to fly long distances with minimal energy exertion (Berthold 2001). The Project ridge is among a series of ridges in the area along which migrating raptors would be expected to occur during migration movements.

Regional Raptor Species

Fifteen species of raptors are expected to occur in Vermont during the breeding and/or migration periods based on their normal geographic range. These species are turkey vulture (*Cathartes aura*) [1], osprey (*Pandion halaeetus*), bald eagle (*Haliaeetus leucocephalus*), northern harrier (*Circus cyaneus*), sharp-shinned hawk (*Accipiter striatus*), Cooper’s hawk (*Accipiter cooperii*), northern goshawk (*Accipiter gentilis*), red-shouldered hawk (*Buteo lineatus*), broad-winged hawk (*Buteo platypterus*), red-tailed hawk (*Buteo jamacensis*), rough-legged hawk *Buteo lagopus*), golden eagle (*Aquila chrysaetos*), American kestrel (*Falco sparverius*), merlin (*Falco columbarius*), and peregrine falcon (*Falco peregrinus*). Species groups are referred to as “Buteos” (red-shouldered hawk, broad-winged hawk, red-tailed hawk, and rough-legged hawk), “Accipiters” (sharp-shinned hawk, Cooper’s hawk, and northern goshawk), and “Falconiformes” (American kestrel, merlin, and peregrine falcon).

Results of Regional Bird Surveys

During fall 2009, the HMANA sites with the highest passage rates included Summitville, NY (28.1 raptors per hour [raptors/hr]), Little Round Top, NH (18.9 raptors/hr), and Putney Mountain, VT (15.1 raptors/hr, HMANA 2009). The most commonly observed raptors at regional HMANA sites during fall 2009 were broad-winged hawks, which constituted the majority of birds seen on many high count migration days at hawk watch sites in mid-September.

[1] While turkey vultures are not phylogenetically considered true raptors, they are diurnal migrants that exhibit flight characteristics similar to *Buteos, Accipiters* and other *Falconiformes* species, therefore vultures are typically included during hawk watch surveys.

Between 1999 to 2008, passage rates during pre-construction spring migration surveys at proposed wind sites ranged from 25.6 raptors/hr at Westfield, Chautauqua County, NY (2003; Great Lakes Shore) to 0.1 raptors/hr at Clinton/Ellenburg County, NY (2005; Great Lakes Plains/Adirondack foothills, see Appendix A, Table 5). Among study sites, the percentage of raptors observed below maximum turbine height ranged from 3 to 94.7 percent (see Appendix A Table 5. During pre-construction fall surveys between 1996 and 2008 at proposed wind sites, passage rates ranged from 12.7 raptors/hr at Deerfield, Bennington County, VT (2004; forested ridge) to 0 raptors/hr at Wethersfield and Bliss in Wyoming County, and Clinton/Ellenburg and Altona in Clinton County, New York (2005; agricultural plateau and Great Lakes plain/Adirondack foothills, see Appendix A, Table 6). The percentage of raptors observed below maximum turbine height at study sites in the fall ranged from 9 to 89 percent (see Appendix A Table 6).

From 1999 to 2009, American kestrel (*Falco sparverius*) was the only raptor detected along the Hardwick, VT USGS BBS route (Figure 1-2, Appendix A, Table 1). The Greensboro, VT survey route documented the occurrence of two species of raptor during surveys from 1999 to 2009: northern goshawk (*Accipiter gentilis*) and American kestrel (Appendix A, Table 2). Northern goshawk is listed as a species of medium priority conservation need under the VT Wildlife Action Plan (VTFW 2005).

The closest Audubon CBC (Craftsbury-Greensboro location [Figure 1-2]) documented the occurrence of six species of raptor and two owl species from 1999 to 2001 within a 24 km diameter circle: northern harrier, sharp-shinned hawk, Cooper's hawk, northern goshawk, red-tailed hawk, rough-legged hawk, northern hawk owl (*Surnia ulula*), and barred owl (*Strix varia*) (Appendix A, Table 3). Northern harrier is listed as a species of high priority conservation need under the VT Wildlife Action Plan; Cooper's hawk and northern goshawk are listed as medium priority species (VTFW 2005).

Peregrine falcons are considered a species of high priority for conservation need in Vermont (VTFW 2005). Peregrine falcon nests (eyries) are typically located on cliffs or anthropogenic structures such as bridges and tall buildings. Peregrine falcons are confirmed breeders at two natural eyrie locations near the Project area in Westfield and Lowell, VT. One location, Hazen's Notch Eyrie, is 7.9 mi northwest of the Project and the other location, Belvidere Quarry Eyrie, is 5.6 miles west of the Project. There is another possible peregrine falcon breeding site on Hazen's Notch in Lowell approximately 10 mi northwest of the Project (Figure 1-2). These locations are included in the peregrine falcon eyrie IBA complex.

Raptor Mortality and Behavioral Data

High raptor mortality at California wind farms was the catalyst for investigations of the effects of wind energy projects on raptors and other birds. The high rates of raptor mortality that have been documented in California, particularly at Altamont Pass, are attributable to at least five factors: high raptor density, high prey density, high turbine density, short lattice towers, and fast spinning blades that appear to blur at high wind speeds. The combination of these factors is unique to older projects within parts of California, although not all projects within that state include all of these features. Certain design features present in some modern wind projects, such as overhead collection lines between turbines, may provide additional roosting habitat for raptors, increasing the risk of electrocution.

Modern projects constructed within the last 5 to 10 years have significantly different characteristics than those found specifically at Altamont Pass and other California developments with high raptor density. In general, newer sites in the east are within areas with much lower raptor density and probably lower prey densities (Erickson *et al*. 2002). Additionally, newer facilities have widely spaced turbines, smooth tubular towers, and blades that spin slowly enough to remain visible even at high wind speeds. These factors are thought to have contributed to lower rates of raptor mortality in the east than those documented in California. Several recent studies conducted in the U.S., outside of California, have documented relatively low raptor mortality with less than 50 total raptor fatalities documented by 25 studies at 20 different locations (with a total of 1,478 turbines operational at the time of study) throughout the U.S. (Appendix A, Table 4). In comparison, there have been more than one hundred raptor mortalities documented per year at Altamont Pass, and estimates of thousands killed annually at that facility alone (Jones and Stokes 2009).

There is additional peregrine falcon collision information that was not part of the 25 studies included in Appendix A Table 4. Peregrine falcons are among species involved with collisions at the Altamont Pass Wind Resource Area in California (Jones and Stokes 2009). However, as indicated previously, the Altamont Pass Wind Resource area has unique topographical features including differences in the abundance of raptors and prey species, as well as out-dated turbine design features which are not characteristic of modern commercial wind farms in the eastern U.S. Peregrine falcon turbine collisions have also been documented at small wind farms located in wetland settings: a peregrine falcon collision was documented at a wind farm located in wetlands in Atlantic City, New Jersey (Clark et al. 2009), and another fatality was documented at a wind farm located in a bog on the Orkney Islands, Scotland (Kingsley and Whittam 2001).

While the ability of raptors to avoid turbines likely depends on a variety of factors, some studies have attempted to quantify or estimate raptor avoidance rates, either through on-site observation or modeling. Birds presumably avoid encountering turbines by seeing the blades or detecting the motion of spinning blades, or by hearing them (Dooling 2002). Avian turbine avoidance rates have been calculated, using a model developed by Whitfield and Madders (2006) known as the “Band Model,” at several existing wind farms in the U.S. Based on results of the model, geese and raptor species have been estimated to have avoidance rates greater than 95 percent (Fernley *et al.* 2006). Golden eagles were reported to have an estimated turbine avoidance rate of 99.5 percent during surveys at a U.S. facility (Chamberlain *et al*. 2006). However, limitations to these calculations include failure to account for differences among bird flight patterns and behaviors under a range of conditions and a general lack of information and data about avoidance behaviors of many species of birds (Chamberlain *et al.* 2006).

Direct observations of turbine avoidance behavior by raptors were made by researchers documenting movement patterns and flight behaviors of birds at the Buffalo Ridge facility in Minnesota. The Project area at Buffalo Ridge consists of upland prairie, prairie wetlands, agricultural land, woodlands, and forested ravines. Birds seen flying through turbine strings often adjusted their flight when turbine blades were rotating and typically made no adjustments when turbines were not operating, supporting the theory that birds can detect blade movement by sight or sound. At the Buffalo Ridge project, American kestrels were often seen at the height of the rotors and within 15 m (50') of turbines. However, no kestrels were found during fatality searches at this site. Buteos were often observed at the height of the rotors, but were infrequently seen within 31 m (100') of the towers. No buteo morality was reported at this facility (Osborn *et al.* 1998).

Due to the overlap in occurrence of seasonally local and migrant raptors at study locations, it is difficult to determine if the raptor fatalities reported in Appendix A Table 4 occurred during localized movements or during long-distance migration movements. Available carcass discovery dates indicate that collision events occur during both breeding and migration seasons (Appendix A, Table 4). Overall, the literature review suggests that, while a variety of raptors are present in the Project area during spring and fall migration, as well as during the breeding season, the likelihood of raptor collision morality at the Project will be low, given the low overall rates of collision mortality observed at other sites in the U.S., outside of California (Appendix A, Table 4), and the high rate of raptor-turbine avoidance behaviors observed.

4.1.1.2 On-site Field Surveys (Measurement Endpoint 1b)

A total of 134 raptors were observed during the spring 2009 raptor survey period. The seasonal passage rate at the Project was 1.81 raptors/hr. This passage rate is low in comparison to the spring passage rates reported at other wind study sites in the region (Appendix A Table 5). Eighty-eight percent of raptor observations occurred at locations within the Project area. Among those raptors that occurred within the Project boundary, 69 percent were flying at or below 135 m, the maximum height of the proposed turbines, for at least a portion of their flight through the Project area. The Bird and Bat Survey report (Stantec 2009a) provides the dates, number of individuals, flight paths or locations, and flight behaviors of raptors observed during the spring surveys.

Of the fifteen species of raptors expected to occur in Vermont, 10 species (not including unidentified accipiter, unidentified buteo, and unidentified raptor) were observed during on-site raptor migration surveys in spring 2009. The species most commonly observed during the spring surveys included turkey vulture and red-tailed hawk. One state endangered raptor species (bald eagle) was observed outside the Project area. This individual was observed south/southwest of the Project area boundary, circle soaring at an approximate height of 500 m (1640 ft) above ground level. Stantec biologists used a radar recording of the flight to estimate the eagle's minimum distance to the Project area boundary, which was 1060 m (3477 ft) (Stantec 2009a).

Spring raptor surveys (Measurement endpoint 1b) documented low to moderate numbers of migrating raptors above the Project area, but relatively high percentages of raptors flying below the maximum height of the proposed turbines. While pre-construction surveys do not provide all the necessary information to predict risk of collision mortality, field surveys do indicate the potential for exposure of raptors to wind turbines at the Project. However, the relatively low numbers of raptors within the Project area overall suggests a low likelihood of impact, especially when considered in light of the results of mortality surveys conducted on forested ridges in the eastern U.S., which have documented very low rates of raptor collision mortality (Appendix A, Table 4; Table 4-1).

Table 4-1. Evaluation of risk of impacts to raptors at the Kingdom Community Wind Project

Assessment Endpoint		Measurement Endpoints		WOE Score	Risk of Impact	Magnitude of Impact	Rationale
1	Potential collision mortality of resident and migratory raptors	1a	Literature Review	Low/ Medium	Yes	Low	Low rates of raptor collision mortality observed at wind facilities in the U.S. (outside of California), high rates of raptor-turbine avoidance behaviors observed.
		1b	Raptor Migration Surveys and Regional Bird Surveys	Medium/ High	Yes	Low	Several species of raptor, including a state-listed species, present in and around Project area during migration, although rates of raptor migration are low relative to other sites. On-site BBS surveys did not document breeding raptors but regional surveys indicate several raptors that breed or over-winter in the region.
2	Potential habitat loss or displacement of raptors from the Project area	2a	Literature Review	Low/ Medium	Yes	Low	Displacement of raptors from direct vicinity of turbines documented at certain operational wind facilities; raptors continue to forage and nest within other facilities indicating the potential for impacts but a low magnitude of impact.
		2b	Habitat Assessment	Medium	Yes	Low	There are no state-listed raptor species known to breed within the Project area. Habitat impacts to raptor species in general would be similar to existing impacts in Project area.

4.1.2 Indirect Impacts (Assessment Endpoint 2)

In addition to direct impacts, indirect impacts may result from development of the Project. Such impacts may include displacement from the direct development area due to loss of habitat, and for certain species, displacement from areas with increased edge habitat or forest fragmentation. Indirect impacts are more subtle, are potentially difficult to document, and may not always be negative. Some species may benefit from the creation of forest edge, which may provide preferred foraging habitat. Other species that are sensitive to human presence and construction or maintenance activities may be displaced. Displacement may result in loss of habitat or decreased breeding success. Certain raptor species would be expected to be more susceptible to displacement impacts or loss of breeding habitat than others. The potential indirect impacts to raptors is dependent on species' use of the Project area, the availability of suitable breeding or foraging habitat on-site, and species' tolerance for human disturbances.

4.1.2.1 Literature review (Measurement Endpoint 2a)

Limited data exist regarding raptor displacement from wind farms in the East. However, data from existing facilities in the West and upper Midwest can be used to extrapolate potential behavioral patterns for similar species in the east. For three years after construction of a facility in Wyoming, a pair of golden eagles successfully nested within 0.8 km (0.5 mi) of the facility (NRC 2007). A Swainson's hawk (*Buteo swainsoni*) nested within 0.8 km of a wind farm in Oregon (NRC 2007). Golden eagle breeding territories were monitored in 2000 and 2005 at a facility in California, and the same nesting territories were used during both years (NRC 2007). Within 2 mi of the Stateline facility in Oregon and Washington, raptor density remained unchanged during a two year post-construction study (NRC 2007).

The majority of available studies conducted in the U.S. indicate that raptors continue to use the area surrounding wind projects. However, breeding habitat displacement was observed at a wind farm in Minnesota. After development of the Buffalo Ridge Wind Farm, raptors continued to nest in the area surrounding the Project; however, no nests were found in similar habitats within the 32 square km (19.9 square mi) facility (NRC 2007). Observed raptors, however, continued to use the Project area while foraging or flying. American kestrels were often seen flying within 15 m (49.2') of turbines (Osborn *et al*. 1998). However, buteos were infrequently seen within 31 m of the towers (Osborn *et al*. 1998).

Based on these results, the potential for indirect impacts to raptors exists at modern wind facilities, although the magnitude of impacts appears to be low (Table 4-1). In addition to displacement, creation of edge habitat and clearing for turbine pads will likely create foraging habitat for certain raptor species, although this is not expected to have a significant effect on the distribution of raptors.

4.1.2.2 Habitat Characterization (Measurement Endpoint 2b)

Habitat exists for some species of breeding and over-wintering raptors including sharp-shinned hawk, Cooper's hawk, northern goshawk, and red-shouldered hawk; however, the Project area does not provide the preferred breeding habitat of the state endangered bald eagle, nor does it offer habitat for other high priority conservation need species including peregrine falcon or northern harrier (*Circus cyaneus*). No raptors were detected on-site during the summer 2009 breeding bird surveys. However, initiation of breeding is typically earlier for raptors than for other avian groups like passerines, and raptors may be more easily detected when establishing breeding territories early in their breeding season. Therefore, it is possible that breeding raptors were present yet not detected during breeding bird surveys. Several species of raptor were however detected in the area during regional bird surveys conducted during the breeding season and during the winter.

The development of new access roads and clearings for the turbine lay-down areas will result in forest disturbance. This type of habitat disturbance is already present in the Project area in the form of existing and historic logging areas. The composition of raptor species that may occur in the Project area is not expected to change dramatically after the proposed development, based on the fact that the Project infrastructure will affect only a very small percentage of available habitat, and this type of habitat disturbance is already present in the landscape. Whereas species categorized as "forest interior" species could be more sensitive to development of the Project, the majority of available habitat is currently disturbed and subject to some level of human presence and activity. For example, species including red-tailed hawk benefit from the creation of cleared areas near woodlands (Preston and Beane 1993). The creation of roads at the proposed Project site may increase foraging habitat for such species. However, the presence of operating turbines or maintenance personnel may discourage more sensitive species such as red-shouldered hawk from breeding or foraging in the area immediately surrounding the turbines.

Magnitude of indirect impacts associated with breeding or over-wintering habitat loss or displacement from habitat is anticipated to be low for raptors based on the results of the habitat characterization (Measurement Endpoint 2b), as the Project will result in a small amount of habitat loss relative to the landscape (Table 4-1).

4.1.3 Conclusions

The overall lack of raptor mortalities documented at existing facilities suggests very low risk of impact to this species group, although available data do not necessarily allow for a more accurate prediction of collision rates, timing of collisions, or species involved. Reasons for this low potential impact are thought to be related to the large size of modern turbines and slow-moving blades, which are likely more easily avoided by diurnally active raptors than the older generation, fast-spinning turbines used at Altamont Pass. Anecdotal observations of raptors avoiding turbines suggest that raptors are generally able to detect and avoid them, and that collisions are unusual at modern wind farms.

Post-construction studies and other literature on raptor collision mortality in the U.S. (outside of California) (measurement endpoint 1a) have documented low raptor fatality numbers, and suggest that raptors are generally not vulnerable to impacts associated with collision mortality at modern wind facilities. On-site raptor migration surveys (measurement endpoint 1b) documented low to moderate numbers of raptors passing through the Project area during spring 2009 with some birds occurring at locations within the proposed rotor-swept zones, indicating a potential for collision events to occur; however, low numbers observed suggest a low magnitude of impacts (Table 4-1). The two measurement endpoints addressing potential indirect impacts to raptors at the Project both indicated a potential for impact, as any type of habitat modification or land clearing can be expected to affect the distribution and species composition of raptors in the immediate area. However, the magnitude of this impact is expected to be low, as the amount of land clearing associated with the Project will be minimal in comparison to the amount of available habitat and will result in habitat alterations similar to those already present in the landscape (Table 4-1).

Field surveys and literature review did not document anything particular about the Project area that would suggest an increased risk to raptors posed by the site, other than the location of the Project within a system of parallel ridges in a region of the country through which a substantial number of raptors migrate annually. Raptor migration surveys at the Project documented low levels of migration relative to Hawk Watch sites, suggesting that the Project itself does not appear to be a point of concentration during migration. Overall, the measurement endpoints indicated a potential risk of direct and indirect impacts, as raptors do migrate through the Project area and the Project will result in a certain amount of forest clearing, but the magnitudes of impact is expected to be low (Table 4-2).

Table 4-2. Concurrence among measurement endpoints for raptors at Kingdom Community Wind.

	Evidence of Impact?/ Magnitude?	**Weighting Factors**				
		Low	**Low/ Medium**	**Medium**	**Medium/ High**	**High**
Increasing Evidence of Risk	Yes / High					
	Yes / Moderate					
	Yes / Low		**1a, 2a,**	**2b**	**1b**	
	No					
	Undetermined					
	Increasing Confidence or Weight					
1a	Literature Review (Potential collision mortality of raptors)					
1b	Raptor Migration and Regional Bird Surveys (Potential collision mortality)					
2a	Literature Review (Potential habitat loss or displacement)					
2b	Habitat characterization (Potential habitat loss or displacement)					

4.2 NOCTURNALLY MIGRATING PASSERINES

4.2.1 Characterization of Nocturnal Passerine Migration

Many small birds, including rails, shorebirds, flycatchers, sparrows, orioles, thrushes, warblers, vireos, as well as many waterfowl, migrate nocturnally (Zimmerman 1998). The majority of nocturnal migrants in eastern North America are warblers, sparrows, thrushes, grosbeaks, and tanagers (Farnsworth 2004). Other species migrate diurnally including waterfowl, loons, gulls, raptors, swallows, nighthawks, and swifts. Some birds, including wading birds, migrate both day and night (Zimmerman 1998).

The peak in bird density in the sky at night generally occurs before midnight (Farnsworth 2004, Zimmerman 1998) and gradually decreases until sunrise (Zimmerman 1998). Most migrants fly at high altitudes, possibly to take advantage of favorable following winds, to prevent overheating, to navigate over landscape features, to fly over fog or clouds, or to avoid physical barriers (Zimmerman 1998). Some birds, including waterfowl and shorebirds, are known to fly at elevations greater than 6,000 m (20,000') (Zimmerman 1998, Sibley 2001). Previous studies have suggested that most small birds migrate at altitudes between 150 and 300 m (492 and 984') (Zimmerman 1998) and that the majority of passerines migrate at altitudes between 90 and 610 m (295 and 2000') (Kerlinger 1995 cited in NRC 2007); however, numerous radar surveys conducted in recent years at proposed wind projects suggest that flight height of nocturnally migrating passerines is relatively constant, and takes place at high altitudes, with mean values for flight heights generally ranging between 300 m and 600 m (985 and 1969') above ground level for entire survey periods (Appendix A, Table 8 in the Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont, Stantec 2009a). A survey of recent radar studies also indicates that approximately 10 percent of migrants fly below 125 m, the maximum height of most modern wind turbines (NRC 2007). Long-distance migrants typically migrate at higher elevations than short-distance migrants. Some shorebird and waterfowl species make non-stop flights between the breeding and wintering grounds, while other species stopover at locations along their migration route to rest and forage. Passerines typically reach peak altitudes just before midnight, and gradually decrease in altitude until sunrise (Able 1970).

While some species are known to travel narrow paths during migration, many species travel broad, generalized routes during migration (Zimmerman 1998). The width of many species' migration corridors may be similar to the width of their breeding range (typically over 3219 km [2000 mi] east to west) (Zimmerman 1998). A study in Europe suggests that species with a broad east-to-west breeding range will cross all topographical features during migration including lakes, river valleys, and mountains (NRC 2007). Soaring birds, such as raptors, are known to concentrate along topographical features in order to take advantage of thermal updrafts; however, further information is needed regarding topography-influenced concentrations of nocturnal migrants (Bruderer 1997). Some reactions to prominent topographical features such as the Alps have been observed: relatively low flying birds have been observed to shift their direction of travel to avoid crossing the Alps, while high flying birds have been observed crossing the Alps (Bruderer 1997). These behaviors may be influenced by topography; however, they are also likely influenced by environmental and biological factors (Bruderer 1997). Many waterfowl follow interior migration paths across North America as they travel to their wintering grounds along the Atlantic Coast from their breeding grounds in Canada. Some waterfowl travel southeast from central Canada, crossing the Great Lakes, New York, and Pennsylvania before reaching their coastal destinations. Certain species travel to and from breeding grounds along elliptical or circular migration routes, potentially to take advantage of seasonal wind conditions (Zimmerman 1998). For example, some species may occur along the eastern coast in the fall and then within the continental interior during migration in the spring.

During the fall, the largest movements of migrants usually occur following the passage of a cold front. Low pressure systems in the spring are associated with large migration movements (Zimmerman 1998). Species will migrate in overcast conditions that are characterized by favorable tailwinds. When weather conditions result in lower flight altitudes, birds may be at increased risk of collision with man-made structures (NRC 2007). Birds will continue migration movements in less favorable winds and increased cloud clover with precipitation; however, storm conditions will result in ‘fall outs’ where birds are forced to wait out adverse weather at stop-over locations. Although birds will still migrate in sub-optimal weather conditions the magnitude of migration is generally lower during these periods than during optimal migration conditions.

4.2.2 Collision Mortality of Nocturnally Migrating Passerines (Assessment Endpoint 3)

4.2.2.1 Literature Review (Measurement Endpoint 3a)

Rates of avian collision mortality documented at existing wind facilities in the eastern and upper mid-west of the U.S. has ranged from 0 to approximately 10 bird fatalities per turbine per year (Appendix A, Table 7). Although avian collision mortality can occur during both the breeding and migration seasons, patterns in avian collision mortality at tall towers, buildings, wind turbines and other structures suggest that the majority of fatalities occur during the spring and fall migration period (NRC 2007). Limited data suggests that roughly half the fatalities at existing wind facilities represent migrant species, while the other half represents resident species (NRC 2007).

The majority of avian carcasses found at existing wind facilities in the U.S. have been those of passerines (78%), while 5.3 percent of carcasses have been waterbirds, 4 percent have been fowl-like birds, 3.3 percent have been starling-pigeon-rock dove species, 2.7 percent have been diurnal raptors, 0.7 percent have been shorebirds, and 0.5 percent have been owls (NRC 2007). Most available data on patterns of avian mortality at wind facilities in the US is from the west and mid-west, although there is a growing database of mortality at existing wind farms in the east. Emerging results of wind farms in the east are consistent with other studies, indicating that passerines comprise the majority of avian fatalities at wind facilities. Seventy-six percent of fatalities at two forested facilities in the east (Buffalo Mountain, Tennessee and Mountaineer, West Virginia) were passerines (NRC 2007). A recent study at the Maple Ridge Wind Power Project in New York reported that 76 percent of avian fatalities were those of night migrants, and 95 percent of identifiable songbird species were night migrants (Jain et al 2009a). The data suggest that it may be the abundance of bird species that is associated with increased risk of collision; passerines are the most abundant terrestrial bird group and also represent the group with the highest observed fatality rate (NRC 2007).

Emerging evidence suggests that certain species of passerines are more susceptible to collision than others. Species most commonly found during carcass searches at Maple Ridge were golden-crowned kinglet (*Regulus satrapa*) (39% of fatalities) and red-eyed vireo (*Vireo olivaceus*) (9.6% of fatalities) (Jain *et al*. 2007). At Mountaineer, West Virginia, red-eyed vireo represented 30% of all fatalities, magnolia warbler (*Dendroica magnolia*) represented 7 percent of fatalities, and blackpoll warbler (*Dendroica striata*) represented 4 percent of fatalities (Kerns and Kerlinger 2004). At the Buffalo Mountain Wind Farm in Tennessee, 25 percent of fatalities were red-eyed vireo, and rose-breasted grosbeak (*Pheucticus ludovicianus*) represented 17 percent of fatalities (Fiedler *et al*. 2007). A recent unpublished study conducted at another wind farm in the northeast, the Mars Hill Wind Farm in Maine, indicated that all birds found during carcass searches were songbird species; blackburnian warbler (*Dendroica fusca*) and golden-crowned kinglets were among the most commonly found species (Stantec 2008c). A few of the songbird fatalities at Mars Hill occurred during the breeding season; therefore, these collisions were not believed to occur during nocturnal migration (Stantec 2008c).

Flight behavior is also believed to be associated with rates of avian collision mortality. Species that migrate at higher altitudes or avoid migrating during inclement weather would be at decreased risk of collision. Birds that migrate diurnally, such as black-capped chickadees (*Poecile atricapillus*), are also at decreased risk of collision. Similarly, species such as Canada goose (*Branta canadensis*) migrate at heights of 300 to 1000 m (984.3 to 3280.8’). Although this species exhibits flocking behavior, which could suggest an increased risk of collision, collisions of these birds with man-made structures are rare and not considered a concern for the species (Mowbray *et al*. 2002). Conversely, birds taking off at dusk and landing at dawn, or birds traveling in low cloud or fog conditions, are likely at the greatest risk of collision.

Although artificial lighting has been thought to influence rates of bird collision at guyed communication towers, buildings, and other tall structures, the blinking FAA lights typically installed on wind turbines do not appear to influence rates of collision (NRC 2007). Jain *et al*. found no significant correlation between mortality rates of nocturnally migrating birds at lit versus unlit turbines at Maple Ridge, NY (Jain *et al.* 2008), and this lack of correlation has been documented at other operational wind facilities (NRC 2007). Kerns and Kerlinger (2004) documented no differences in rates of collision between lit and unlit turbines at the Mountaineer facility in West Virginia. The largest single mortality event documented in their study (33 passerines in one night) was thought to be due to a combination of foggy conditions and bright sodium vapor lighting at a substation within the facility, and not related to the FAA-required lighting on the turbines themselves (NRC 2007).

A recent large collision event documented at a school on Backbone Mountain, near the Mountaineer wind facility in West Virginia, further suggested the potential for bright lighting, combined with foggy conditions, to result in high collision mortality of nocturnal migrants. On the morning of September 29, a total of 494 songbirds, many of them warblers, collided with windows of the school during a relatively short period of time before and after sunrise (Christy Johnson-Hughes, WVUSFWS, personal communication). This unprecedented mortality event was thought to be related to recent installation of bright lighting surrounding the school, which presumably attracted large numbers of birds, many of which collided with the building. The documentation of isolated, large scale mortality events such as this suggest that nocturnal migrants are susceptible to collision on an episodic basis rather than a continuous, predictable level, with factors such as lighting, weather conditions, and seasonal timing playing important roles in determining when collision events occur.

While available literature on avian collision at wind farms is limited, it has recently been increasing due to an increase in projects available for study. Because of this increase, certain predictions can be made about patterns of collision mortality of nocturnally migrating passerines at the Project. Appendix B, Table 1 discusses the species that are at increased risk of collision impact during the migration period, based on their behavior and abundance or due to relatively high mortality rates at existing facilities. Although the species included in the list are not the only species that may experience collision mortality at the Project, available data suggest that these species may be at increased risk of collision either because the species have experienced high mortality at existing facilities or because they are species of conservation concern that are known to occur in and also migrate through the region. The information in the table is based on the most recent data from existing wind farms in the east, population estimates and trends, and known migration collisions with man-made structures.

The majority of avian fatalities at existing wind farms appear to be of nocturnally migrating songbirds. The factors that influence increased risk of collision appear to be a combination of overall abundance, weather, and species specific flight behaviors. Mortality associated with collisions with modern wind turbine models in the U.S. have not been known to result in a significant population level impact to any one species, mainly because the species with relatively high collision mortality are regionally abundant. Collision mortality at the Project is expected to be within the range of mortality observed at existing facilities on forested ridges in the northeast. A population level impact for any single species is not anticipated to result from collision mortality during migration.

4.2.2.2 Nocturnal Marine Radar Surveys (Assessment Endpoint 3b)

Nocturnal marine radar surveys were conducted for 20 nights in fall 2008 and 15 nights in spring 2009 (Table 2-1). Mean passage rate was 356 ± 30 targets per kilometer per hour (t/km/hr) in the fall and 223 ± 16 targets per kilometer per hour (t/km/hr) in the spring. Mean flight height was 350 m ± 9 m in fall 2008 and 298 m ± 10 m in spring 2009. The overall percent of targets flying below the proposed rotor zone was 16 percent for the fall 2008 survey and 21 percent for the spring 2009 survey (Stantec 2009a). Passage rates documented at the Project were within the middle of the range of those documented in most publicly available radar surveys (Appendix A, Table 8 in Stantec 2009a).

Although not conducted during the same nights and year, the results documented at the Project were similar to the results of pre-construction radar surveys conducted at (1) the only two operational wind projects in New England with publicly available post-construction monitoring results, (2) those that are operational and do not have publicly available post-construction results, and (3) those that have recently been granted permits at the state level. These projects include the Sheffield Wind Project, VT, Deerfield Wind Project, VT, Lempster Wind Project, NH, Mars Hill Wind Project, ME, and the Kibby Wind Project, ME (Table 4-3).

Table 4-3. Pre-construction Radar Survey Results at Projects in VT and New England									
Project	**Mean Passage Rate (t/km/hr)**		**Mean Flight Height (m)**		**Mean Percent Below Proposed Turbine Height**		**Mean Flight Direction (degrees)**		**Project Status**
	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	
Kingdom Community Wind, VT	223	356	298	350	(135 m) 21%	(135 m) 16%	81	226	N/A
Sheffield Wind Project, VT	166	91	552	566	(125 m) 6%	(125 m) 1%	40	200	Permitted
Deerfield Wind Project, VT	263	559	435	395	(100 m) 11%	(100m) 13%	58	221	Permitted
Lempster Wind Project, NH	542	620	358	387	(125 m) 18%	(125 m) 8%	49	206	Operational
Mars Hill Wind Project, ME	338	512	384	424	(120 m) 14%	(120 m) 8%	58	228	Operational
Kibby Wind Project, ME (Kibby Range 1)	197	201	412	352	(120 m) 22%	(125 m) 12%	50	196	Operational
Kibby Wind Project, ME (Kibby Mountain)	456	565	368	370	(120 m) 14%	(125 m) 16%	67	167	
Kibby Wind Project, ME (Valley)	443	452	334	391	(120 m) N/A	(125 m) 16%	61	193	

Stantec conducted pre-construction nocturnal radar surveys at the projects listed above during the spring and fall migration periods between 2004 and 2009. Although variable between sites, the majority of operational or permitted projects had higher seasonal mean passage rates than observed at the Project. More significantly, trends in flight heights and flight directions were similar among regional projects and targets were mainly at heights above the proposed turbine height. This may indicate that nocturnal migrants are moving across the landscape in a broad front manner and are consistently at heights above the proposed turbines and are therefore not impeded by topography.

Although the final reports have not been released, preliminary information from post-construction survey results at the Lempster Wind Project and Mars Hill Wind Project suggest that mortality rates for nocturnally migrating passerines are low. Only one bird carcass was found during turbine searches at Lempster between April 20 and June 1, 2009 (Tidhar 2009a). At the Mars Hill Wind Project during post-construction monitoring in 2007 and 2008, bird fatalities were also low. A total of 22 birds were found during turbine searches in 2007 and 21 birds were found in 2008 (Stantec 2008c and Stantec 2009c). Although pre-construction passage rates documented at Lempster and Mars Hill were among the highest documented in the region (Appendix A, Table 8 in the Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont, Stantec 2009a), post-construction survey results documented low levels of bird collision mortality for nocturnal migrants (Stantec 2008c, Stantec 2009e, Tidhar 2009a). This demonstrates the challenge with correlating pre-construction radar survey results with post-construction fatalities, or even predicting general risk, when there are low numbers of nocturnal migrant fatalities: when pre-construction passage rates are higher at one project than another, it does not equate to higher risk of mortality at that Project. Nevertheless, operational facilities such as the Lempster Wind Project and Mars Hill Wind Project, which are similar in elevation and habitat to the Project, may provide useful insight as to potential impacts to nocturnally migrating passerines at the Project.

Because radar surveys were conducted from the same location at the Project during fall 2008 and spring 2009, differences in passage rates between fall and spring surveys likely represent variability in nocturnal migration between seasons rather than differences in site characteristics. Typically, the fall songbird migration would be expected to be heavier, due to the fact that the migratory flock includes young of the year as well as adults returning from their breeding range. This trend was observed at the Project, where the season mean fall (355 t/km/hr) passage rate was about 1.5 times that of the spring passage rate (223 t/km/hr). A more significant trend observed during both spring and fall surveys is a considerable night to night variation in passage rates, indicating that nocturnal migration is episodic, likely due to regional and local weather patterns, wind speed and direction, and other factors.

Unlike passage rates, flight heights were quite consistent between survey nights and between fall and spring surveys. A difference of only 52 m was observed between the season mean flight height during fall and spring at the Project. The bulk of targets were recorded at heights between 200 m and 500 m above ground level during both fall 2008 and spring 2009 radar surveys. This is quite typical of radar surveys, and is a consistent pattern observed across most radar surveys.

Overall, results of radar surveys suggest that migration patterns of nocturnal migrants are similar between fall and spring, and that flight height is consistent. While nocturnal migrants are passing through the air space above the Project area, the majority of targets are flying above the height of the proposed wind turbines. A relatively small percentage of targets fly below turbine height on most nights, and many of these targets were detected to one side of the ridge or another and not directly above the proposed turbines. Therefore, while some nocturnal migrants are present within the rotor zone of proposed wind turbines, this measurement endpoint suggests that the magnitude of collision mortality of nocturnal migrants is expected to be low (Table 4-4).

Table 4-4. Evaluation of risk of impacts to nocturnally migrating passerines at the Kingdom Community Wind Project

Assessment Endpoint		Measurement Endpoints		WOE Score	Risk of Impact	Magnitude of Impact	Rationale
3	Potential collision mortality of nocturnally migrating passerines	3a	Literature Review	Low/ Medium	Yes	Low	While impacts to nocturnally migrating passerines have been documented at most wind energy facilities, rates of collision appear to be low relative to regional population size.
		3b	On-site Radar Surveys	Medium	Yes	Low	Radar surveys documented moderate passage rates, but most targets flying at heights above proposed turbine height

4.2.3 Conclusions

Potential impacts to nocturnally migrating passerines are expected to be minor. Although on-site field surveys documented nocturnally migrating passerines moving through the Project area in relatively low to moderate numbers compared to regional survey results, the vast majority of individuals were flying at consistently high altitudes above the height of the proposed turbines. Literature review suggested that impacts to nocturnally migrating passerines do occur at most wind energy facilities. However, the magnitude of impacts are likely low, since the number of individuals that have collided with turbines is very small relative to the large number of individuals moving through the landscape, and as compared to regional population levels. Patterns of mortality (species composition, seasonal timing) are expected to be similar to operational projects in New England where mortality has been relatively low. Overall, both measurement endpoints indicated a potential for direct impacts, as nocturnally migrating passerines do migrate through the Project area, but the magnitude of impact should be low, since the majority are flying at heights above the proposed turbine height, and since rates of collision appear to be low relative to the regional population size (Table 4-4).

Table 4-5. Concurrence among measurement endpoints for nocturnally migrating passerines at the Kingdom Community Wind Project.

Increasing Evidence of Risk	Evidence of Impact?/ Magnitude?	Weighting Factors: Low	Low/ Medium	Medium	Medium/ High	High
	Yes / High					
	Yes / Moderate					
	Yes / Low		**3a**	**3b**		
	No					
	Undetermined					
	Increasing Confidence or Weight					
3a	Literature Review (Potential collision mortality of nocturnally migrating passerines)					
3b	On-site Radar Surveys (Potential collision mortality of nocturnally migrating passerines)					

4.3 BREEDING BIRDS

This section characterizes the non-raptor breeding bird population. Information regarding raptors that may breed within the Project area is described in Sections 3.1 and 4.1.

4.3.1 Characterization of the Breeding Bird Community

On-site breeding bird surveys (BBS), supplemented with USGS BBS, Audubon CBC, and eBird data, provide the most site-specific and representative data available on species composition and relative abundance of breeding birds in the vicinity of the Project area. While one summer season of on-site surveys does not necessarily enable identification of all species of breeding birds present, these on-site data combined with USGS BBS and Audubon CBC data collected in the vicinity of the Project over several years provide an accurate representation of the local breeding bird community.

Breeding bird surveys at the Project documented a total of 36 species in summer 2009, including an unidentified woodpecker (1 individual) and unidentified passerines (2 individuals). Point-counts at proposed turbine locations documented 33 species, of which the three most common were white-throated sparrow (*Zonotrichia albicollis*; n=30), black-throated blue warbler (*Dendroica caerulescens*; n=21), and dark-eyed junco (*Junco hyemalis*; n=21). In general, species documented in the Project area were typical of the moderate elevation northern hardwood forests that dominate the Project area. All species observed, the number of individuals, relative abundance, and frequency of occurrence of species detected during the 2009 breeding bird surveys are available in the document Bird and Bat Surveys for Kingdom Community Wind in Lowell, Vermont (Stantec 2009a).

The uniformity of habitats within the Project area resulted in similar species composition between point counts. Overall, the assemblage of breeding bird species within the Project area is composed of primarily forest interior breeders, as well as some species associated with forest edge and disturbed forest habitats. Unusually large numbers of birds or unusually high species diversity were not documented during on-site surveys. Regional breeding bird surveys documented a greater diversity of species, as these surveys sampled additional lower elevation habitats. Regional surveys also provide multiple years of data, resulting in higher species richness.

There were no federal or state listed threatened, endangered, or species of special concern observed during on-site BBS or Bicknell's thrush surveys in 2009. Of the 61 bird species of greatest conservation need and state listed species in Vermont's Wildlife Action Plan, seven were documented in the Project area either during point count surveys, raptor surveys,or incidentally between point counts (Appendix A, Table 8). Of these 61 species, 31 were detected during the regional surveys (CBC, Audubon BBS, and eBird data). Again, the higher species diversity documented in regional surveys is primarily a result of the fact that regional surveys sampled a greater diversity of habitats, were conducted at lower elevations with generally milder conditions, and occurred over many years. Additional years of breeding bird surveys at the Project would likely document year-to-year shifts in species composition and abundance, and would likely add a small number of additional species each year, but would not be expected to document a breeding bird community significantly different from that characterized by the on-site surveys conducted in 2009. Of the seven species listed in Vermont's WAP that were documented in the Project area, six species are listed as medium priority and are not considered regionally rare. Canada warbler (*Wilsonia canadensis*) is the only species documented with a high priority listing; this listing is due to decreasing population trends statewide and unclear habitat requirements.

4.3.2 Collision Mortality to Breeding Birds (Assessment Endpoint 4)

4.3.2.1 Literature Review (Measurement Endpoint 4a)

Literature review of the risk of collision mortality to breeding birds suggests that, whereas the majority of documented avian collisions are thought to occur during spring and fall migration periods, avian collision mortality can occur during the breeding season as well. Most mortality studies have not been able to accurately distinguish between resident and breeding bird fatalities. Limited data suggest that roughly half the fatalities at existing wind facilities represent migrant species, while the other half represents resident species (NRC 2007).

Factors that could influence the susceptibility of breeding birds to collision mortality include abundance, foraging behavior, and other behaviors such as courtship displays. In the west and midwest, the species most commonly found at existing facilities are those that are locally abundant: horned lark (*Eremophila alpestris*), vesper sparrow (*Pooecetes gramineus*), and bobolink (*Dolichonyx oryzivorus*). However, these species also engage in courtship displays which may result in flights within the rotor zone of turbines (NRC 2007). Many species of songbirds, including wood warblers, engage in territorial or courtship chasing flights during the breeding season, which may also increase their risk of collision. Although many passerines are foliage gleaners or ground foragers and therefore are at decreased risk of collision while foraging, some species engage in insect or bird ‘hawking’ behaviors that may put them at increased risk of collision at certain times.

While abundance and certain flight behaviors may increase risk of collision to certain breeding bird species, other species apparently avoid turbines. Crows and ravens (*Corvus spp*.) are often seen flying at heights that would be within the rotor zone of wind turbines and are often present in large numbers, yet they are rarely found during fatality searches (NRC 2007). Similar to raptors, breeding birds can presumably avoid encountering turbines by seeing the blades or detecting the motion of spinning blades, or by acoustically detecting them (Dooling 2002).

Avian turbine avoidance behaviors are presumably species specific and are dependent on a range of environmental factors including visibility and auditory conditions. To some extent, resident birds are anticipated to habituate to the presence of turbines, as they have to other man-made structures such as bridges, buildings, and communication towers. Birds have been observed to become habituated to turbines and have been seen frequently flying between strings of non-operational turbines (Osborn *et al*. 1998).

Landscape features may also influence risk of collision mortality to breeding birds. Although there are currently no strong correlations demonstrated between habitat type and avian fatalities at wind farms, certain resources may influence bird abundance and susceptibility to collision including proximity to nesting habitat, prey abundance, water availability, or vegetation structure (NRC 2007). Habitat features that concentrate bird abundance or activity presumably increase risk of collision mortality. Modern turbine designs present less of an attraction to perching or nesting birds than the shorter, lattice-style towers used at older facilities, although other modern facility design features, such as overhead collection lines between turbines, may increase the risk of collision by providing additional roosting habitat for raptors (and thus increasing the risk of electrocution).

The factors that influence increased risk of collision appear to be a combination of overall abundance, as well as species specific flight behaviors. Mortality associated with collisions with modern wind turbine models in the US will not likely result in a population level impact to any one species, mainly because the species with relatively high collision mortality are locally abundant species. Overall, literature review (measurement endpoint 4a) indicates that impacts to breeding birds could occur, although the expected magnitude of these impacts is low (Table 4-6).

Table 4-6. Evaluation of risk of impacts to breeding birds at the Kingdom Community Wind Project							
Assessment Endpoint		**Measurement Endpoints**		**Weighting Score**	**Risk of Impact**	**Magnitude of Impact**	**Rationale**
4	Potential collision mortality of breeding birds	4a	Literature Review	Low/ Medium	Yes	Low	Collision mortality has been shown to occur for breeding birds, but at lower rates than during the migratory periods.
		4b	On-site and Regional Bird Surveys	Medium/High	Yes	Low	Bird surveys documented typical abundances and species composition of breeding birds. Likelihood of collision is expected to vary by species depending on behavior and abundance.
5	Potential indirect impacts to breeding birds	5a	Literature Review	Medium	Yes	Low	Habitat removal and alteration will likely cause shifts in species abundance in the immediate vicinity of turbines and access roads. However, wind facilities generally result in a relatively small amount of clearing.
		5b	Habitat Characterization	Medium	Yes	Low	Habitats are currently relatively disturbed and fragmented due to past timber harvesting activities. The small amount of clearing associated with the Project relative to the available habitat present is expected to cause certain shifts in species distribution around turbines and access roads, but overall indirect impacts are expected to be minimal.

4.3.2.2 On-site and Regional Bird Surveys (Measurement Endpoint 4b)

According to the general understanding of interactions between breeding birds and wind turbines, species of breeding birds most susceptible to collision mortality at the Project would include those with high abundances in the Project area, those with behaviors that would cause them to fly in the rotor zone of the proposed turbines, and those species that have been most commonly found at mortality studies conducted at other operational facilities. Results of on-site BBS and regional data sets regarding avian species composition and abundance suggest that the breeding bird population at the Project is relatively limited in comparison to the surrounding region; this may due to the fact that habitat diversity is low within the ridgeline Project area, and that conditions are generally harsher and presumably less suitable for nesting habitat than in the surrounding valleys and plateaus. However, although species richness within the Project area was considerably lower than that documented regionally, the high elevation and relatively contiguous forest provides habitat for species that are not found in the valleys and plateaus.

While overall risk of collision mortality to breeding birds is expected to be low, certain species are likely to be at slightly higher risk than others, based on their relative abundance, behaviors, or mortality data from other wind facilities. Appendix B, Table 2 lists species that could be at increased risk of collision mortality at the Project during the breeding period based on these factors. The species included in the list are not the only species that may experience collision mortality during the breeding season at the Project; however, based on available information, these species are believed to be at increased risk of impact. Among these (but not limited to) are the ovenbird (*Seiurus aurocapillus*), rose-breasted grosbeak, red-eyed vireo, blackpoll warbler and white-throated sparrow. The table also includes species of conservation concern that were documented in the Project area. Whereas most of these species were not present in the Project area in large numbers, they could suffer greater cumulative impacts due to their vulnerable populations. However, these species would likely not constitute a large number of fatalities at the Project.

Overall, collision mortality of breeding birds at the Project is expected to be within the range of mortality observed at existing facilities in the northeast, although differentiation between mortality of breeding and non-breeding passerines is difficult (Appendix A, Table 5). Results of on-site and regional bird surveys (measurement endpoint 4b) suggest that, while impacts to breeding birds may occur, the magnitude of these impacts is expected to be low (Table 4-6). Moreover, the Project area does not appear to support large numbers of any RTE bird species during the breeding season and impacts to these species are expected to be minimal. A population level impact for any single species is not anticipated to result from collision mortality during the breeding season.

4.3.3 Indirect Impacts (Assessment Endpoint 5)

4.3.3.1 Literature Review (Measurement Endpoint 5a)

In addition to direct impacts associated with collision mortality, development of wind facilities can result in indirect impacts associated with habitat loss or displacement of species. These types of impacts are potentially complex, involving shifts in species abundance, turbine avoidance, habitat use, and behavioral disruption. While wind facilities generally result in relatively small amounts of habitat loss, they create a considerable amount of edge habitat associated with turbine pad clearings, new roads, and transmission lines.

The creation of edge habitat in previously forested areas may decrease the abundance of forest interior species while increasing the abundance of predatory species such as American crow or blue jay (*Cyanocitta cristata*), or brood parasitic species such as brown-headed cowbird (*Molothrus ater*). Additionally, increased human presence around nesting areas due to maintenance activities may decrease the reproductive success of more sensitive species. The level of habitat disturbance associated with the Project relates to the topography, the conditions of habitats present, the amount of existing roads or infrastructure, and the turbine layout (NRC 2007). Habitat disturbances would be species specific and would depend on the condition and availability of habitat prior to construction (NRC 2007). Species with specific habitat requirements or species of conservation concern would be at increased risk of impact due to habitat modifications. Forest dwelling species such as wood thrush (*Hylocichla mustelina*) or blue-headed vireo (*Vireo solitarius*) require extensive tracks of undisturbed forest for successful reproduction.

At wind farms, an estimate of the total area disturbed per turbine ranges from one to three acres (NRC 2007). However, impacts such as edge effect may extend as far out as 100 to 340 m (330' to 1122') from the footprint of a turbine for some forest interior species (NRC 2007). Habitat loss due to the modification of habitat or displacement due to an edge effect or fragmentation may be long-term for some species, whereas habitat loss due to displacement because of disturbances associated with construction may be temporary for some species (NRC 2007). The creation of forest edge habitat results in net loss of habitat for some forest dwelling species, while the same impact may increase the local population of species including brown thrasher (*Toxostoma rufum*), Northern cardinal (*Cardinalis cardinalis*), Northern mockingbird (*Mimus polyglottos*), ruffed grouse (*Bonasa umbellus*), and wild turkey (*Meleagris gallopavo*) (NRC 2007). The decrease of forest canopy can improve habitat for shrub-nesting species such as eastern towhee (*Pipilo erythrophthalmus*), indigo bunting (*Passerina amoena*), and song sparrow (*Melospiza melodia*). However, species such as ovenbird and blackburnian warbler (*Dendroica fusca*) may be impacted by the removal of stands of mature hardwood trees (NRC 2007). Historically, forest harvesting and other impacts have resulted in decreases in the populations of ovenbird, Kentucky warblers (*Oporornis formosus*), and worm-eating warblers (*Helmitheros vermivorus*). In grassland settings, development may increase habitat for some species that nest on recently disturbed ground such as many species of sparrow (Johnson *et al*. 2000).

Some species have a greater tolerance than others for human activity and habitat modification in the vicinity of nesting areas. Although the majority of grassland nesting birds decreased their use adjacent to the turbines at the constructed Buffalo Ridge facility, waterfowl continued to use the area. For example, a mallard nested 31 m (100') away from one of the turbines, suggesting some waterfowl become habituated to the presence of turbines (Osborn *et al*. 1998). Another wind power facility located in grassland habitat did not cause large-scale displacement of grassland nesting birds; savannah sparrow (*Passerculus sandwichensis*) and bobolink (*Dolichonyx oryzivorus*) densities at the Maple Ridge Wind Power Facility were compared to undeveloped nearby reference plots, and it was found that nesting savannah sparrow populations suffered no displacement, and nesting bobolink populations were minimally affected only at distances under 100 m from the turbine (Kerlinger and Dowdell 2008).

There are limited data available addressing impacts to birds associated with habitat loss due to wind farm developments in the U.S., as the majority of studies have focused on the more direct impact of collision mortality. A study conducted at the Buffalo Ridge facility indicated that some species were more susceptible to displacement than others, including common yellowthroat (*Geothlypis trichas*) and grassland nesting species. Species were generally displaced from areas less than 100 m from the towers (NRC 2007, Johnson *et al*. 2000). However, analysis indicated that the turbines did not affect use of the area within 100 m from the towers for 65 percent of bird groups (waterfowl, shorebirds, doves, flycatchers, corvids, blackbirds, chickadees/nuthatches, tanagers/orioles, and thrushes; Johnson *et al*. 2000).

Habitat impact information is more limited for existing wind facilities in the east on forested mountain ridges. Breeding bird surveys were conducted prior to construction, during construction, and after construction at the Green Mountain Power Corporation’s Wind Power Facility in Searsburg, Vermont. The same diversity of species was detected during the three survey periods; however, the abundance and frequency of species at study sample sites changed over the three periods. Four of the most abundant species prior to construction, Swainson’s thrush (*Catharus ustulatus*), white-throated sparrow, ovenbird, and red-eyed vireo, experienced declines in abundance during post-construction surveys. The decline was believed to be a result of the creation of forest edge as these birds are primarily forest interior species. Some species including blackpoll warbler, magnolia warbler (*Dendroica magnolia*), and dark-eyed junco remained unchanged. Yellow-rumped warbler (*Dendroica coronata*) and other edge species such as American robin (*Turdus migratorius*) and blue jay increased in abundance (Kerlinger 2002). At the Lempster Wind Project a common nighthawk (*Chordeiles minor*) nest was observed during pre-construction surveys and was documented again at the project in the vicinity of operating turbines in July, at the end of nesting season (Tidhar 2009b).

Habitat modifications that occur during activities such as logging, residential development, and wind development have resulted in observable changes in the abundance of locally breeding birds. Impacts associated with habitat modification have resulted in the direct loss of habitat, as well as other indirect effects such as increased exposure to brood parasitism or nest predation. Habitat decline is a major factor associated with the declining populations of many avian species in the U.S. At wind facilities, turbines located in unique habitats that support sensitive species may present more of a risk of impact. Species with specific habitat requirements and species of conservation concern are more susceptible to impacts associated with habitat modification.

Overall, literature review regarding the likelihood of indirect impacts to breeding birds (measurement endpoint 5a) suggests that some indirect impacts will likely occur as the result of the Project, but that the magnitude of these impacts will be minimal, as the Project will result in a relatively small amount of clearing relative to the entire Project area. In addition, this area has experienced frequent changes in habitat conditions due to timber harvesting activities to which the breeding bird population has likely become accustomed to (Table 4-6). These impacts are expected to consist primarily of shifts in distribution of species within the Project area which could also occur as the result of other types of impacts, such as timber harvesting.

4.3.3.2 On-site General Habitat Characterization (Measurement Endpoint 5b)

As described in several sections of this document, habitats at the Project consist of a mid-successional northern hardwood – mixed conifer forest. Within the Project area, ridgeline heights are relatively uniform: topographic variation ranges from 2,190' to 2,640' along the ridgeline.. The forest structure is influenced by a long tradition of timber harvesting in the area, although small pockets of late successional red spruce exist on the steeper and less accessible slopes. Throughout the Project area, forests have been recently cut, and are fragmented by existing haul roads and clearings.

Despite some anthropogenic impact, the forest is a largely intact mid-successional ecosystem. The bird species breeding within the Project area include both interior species, such as black-throated green warblers (*Dendroica virens*), and edge-associated species, such as black-capped chickadee. Impact on breeding bird species is likely to be complex and highly species-specific. While some species may be negatively affected by habitat changes or inter-species competition, others may benefit from these changes. Interior forest species, such as ovenbird, that are more typically associated with contiguous forests, may shift their local distribution in response to construction of the Project, but are expected to remain within the Project area. Appendix B, Table 3 lists the non-raptor breeding bird species at higher potential risk of indirect effects due to loss of habitat or disturbance. Because much of the Project area has been previously logged, the composition of the species present is not likely to change significantly after development.

Whereas indirect impacts of habitat loss and creation of edges will not necessarily diminish the overall abundance of breeding birds in the Project area, species composition of birds will likely shift in areas containing turbines, with forest interior species becoming less abundant and forest edge species becoming more common. Also, increased human activity may cause displacement of species such as blue-headed vireo and black-throated blue warblers, which are more sensitive to human activity in the vicinity of nests and may experience decreased breeding success.

Based on field surveys and the habitat characterization (measurement endpoint 5b), indirect impacts are expected to include species shifts such as a reduction in forest interior species and an increase in forest edge species in the immediate Project footprint. However, the magnitude of these impacts is expected to be relatively minimal, considering the fact that much of the habitat in the Project area is currently fragmented by timber harvesting and existing development, many of the species observed during field surveys are forest edge species rather than forest interior species, and the footprint of development areas is relatively small (Table 4-6).

4.3.4 Conclusions

Potential impacts to breeding birds are expected to be minor. On-site breeding bird surveys documented typical abundances and species composition of breeding birds. Based on comparison to regional surveys conducted in at lower elevations in adjacent valleys with more diverse habitats, breeding bird diversity is relatively low within the Project area. Literature review suggested that while collision mortality has been documented for breeding birds at existing facilities, birds seem to be less prone to collision during the breeding season than during the spring and fall migration. Indirect impacts to breeding birds associated with habitat conversion are expected to cause limited shifts in species distribution and abundance and are expected to affect certain species more than others. Breeding bird habitat currently within the Project area consists of a mosaic of second growth and successional forest with a history of timber harvests. Because many of the common species in the Project area are edge-associated species, typically inhabiting areas with human activity, many breeding bird species are expected to become habituated to the presence of the turbines. Certain forest interior species may be indirectly impacted by the Project. However, overall indirect impacts to breeding birds are expected to be minimal, and the type of clearing associated with the Project is not expected to dramatically alter the breeding bird community in the Project area. All measurement endpoints used to assess potential direct and indirect impacts predicted that, while impacts could occur, the magnitude of these impacts is expected to be low. Furthermore, no federally or state listed threatened or endangered species were observed in the Project area during breeding bird surveys (Table 4-7).

Table 4-7. Concurrence among measurement endpoints for breeding birds at the Kingdom Community Wind Project.

Increasing Evidence of Risk

Evidence of Impact?/ Magnitude?	**Weighting Factors: Low**	**Low/ Medium**	**Medium**	**Medium/ High**	**High**
Yes / High					
Yes / Moderate					
Yes / Low		**4a**	**5a, 5b**	**4b**	
No					
Undetermined					

Increasing Confidence or Weight

4a	Literature Review (Potential collision mortality of breeding birds)
4b	On-site and regional bird surveys (Potential collision mortality of breeding birds)
5a	Literature Review (Indirect impacts to breeding birds)
5b	Habitat assessment (Indirect impacts to breeding birds)

4.4 BATS

4.4.1 Characterization of the Bat Community

Nine species of bats occur in Vermont, based upon their normal geographical range. These are the little brown bat (*Myotis lucifugus*), northern long-eared bat, (*M. septentrionalis*), eastern small-footed bat (*M. leibii*), Indiana bat (*M. sodalis*), silver-haired bat (*Lasionycteris noctivagans*), tri-colored bat (*Perimyotis subflavus*), big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), and hoary bat (*L. cinereus*) (Whitaker and Hamilton 1998). At the federal level, the Indiana bat is listed as endangered under the Endangered Species Act (7 U.S.C. § 136, 16 U.S.C. § 1531 et seq.). At the state level, the Indiana bat is listed as endangered, and the eastern small-footed bat is listed as threatened, with a rank of S1 ("Critically Imperiled"), under the Vermont Endangered Species Law (10 V.S.A. Chap. 123 section 5401). All nine bat species found in Vermont are listed as Species of Greatest Conservation Need under Vermont's Wildlife Action Plan (VFWD 2005). Six are high priority species (Indiana bat, small-footed bat, silver-haired bat, tri-colored bat, eastern red bat, and hoary bat), and three are medium priority species (little brown bat, northern long-eared bat, big brown bat).

The proposed KCW Project is located in Orleans County, VT, which is outside the known range of the Indiana bat, but within the range of all other species found in Vermont (DeGraaf and Yamasaki 2001, Whitaker and Hamilton 1998). Based on available habitat within the Project area, existing cleared areas, timber harvest roads, and other linear features provide potential foraging habitat for the remaining eight bat species. The little brown bat, northern long-eared bat, and big brown bat are likely among the most common species based on the largely forested habitat and generally widespread nature of these species (DeGraaf and Yamasaki 2001). The eastern small-footed bat is considered one of the rarer bats in the eastern U.S. (Best and Jennings 1997).

4.4.2 Potential Collision Mortality of Bats (Assessment Endpoint 6)

4.4.2.1 Literature Review (Measurement Endpoint 6a)

Mortality of eight bat species has been documented at wind energy facilities in the eastern U.S. (Kunz *et al*. 2007a), with most fatalities occurring during what is generally considered the fall migration period (August to November; Arnett *et al*. 2008, Cryan 2003, Cryan and Brown 2007, Johnson *et al*. 2005). Species documented under turbines in the east include little brown bat, northern long-eared bat, tri-colored bat, seminole (*Lasiurus seminolus*), silver-haired, hoary, eastern red, and big brown bats. With the exception of tri-colored bats, the species killed most frequently—hoary, red, and silver-haired bat—are long-distance migrants, traveling dramatically greater migration distances than other North American species (Cryan 2003, Cryan *et al.* 2004, Cryan and Brown 2007, Cryan and Barclay 2009). Hoary, red, and silver-haired bats are closely related members of the *Lasiurus* and *Lasionycteris* genera, and it has been hypothesized that the migratory behavior of these species leads to their propensity to strike wind turbines (Cryan and Brown 2007, Cryan and Barclay 2009, Kunz *et al*. 2007a, 2007b). Of the eight eastern species documented in post-construction mortality surveys, only the seminole bat does not occur in Vermont (BCI 2001, DeGraaf and Yamasaki 2001, Whitaker and Hamilton 1998).

There are numerous hypotheses attempting to explain bat fatalities at wind energy sites (Cryan 2008, Cryan and Barclay 2009, Kunz *et al*. 2007a). Hypotheses can be divided into two groups: proximate and ultimate (Cryan and Barclay 2009). Proximate hypotheses attempt to explain *how* bats die at turbines: direct collision with stationary towers, direct collision with rotating blades, or through barotrauma (internal injuries as a result of exposure to rapid pressure changes near the edges of blades; Baerwald *et al.* 2008). Evidence suggests that proximate causes of death are due to collision with moving rotor blades and barotraumas (Cryan and Barclay 2009). Since bat fatalities have not been reported at turbines whose blades are stationary, and since it is rare to observe bat fatalities at other tall, stationary structures such as meteorological towers, it is unlikely that bats collide with stationary turbine towers (Arnett *et al.* 2008). Further evidence that mortality is due to moving blades rather than stationary towers comes from studies showing reduced mortality as a result of reduction in turbine operation (Arnett *et al.* 2009, Baerwald *et al.* 2009). In cases where carcasses do not outwardly exhibit fatal injuries, the cause of death has been determined to be barotrauma (Baerwald *et al.* 2008). In this case, internal injuries as a result of extreme changes in pressure near the tip of each moving blade have resulted in mortality.

Ultimate hypotheses attempt to explain *why* bats die at turbines, and can be broken down into three groups: random, coincidental, and attraction hypotheses. Random hypotheses posit that mortality is a random event, with fatalities proportional to bats present in the area. If bat fatalities were due to random events, then the composition and demographics of fatalities should reflect the bats present in the area. However, there has been little correlation shown between species composition of fatalities at a site and species composition in the area (Cryan and Barclay 2009). Fatalities are skewed towards migratory species and toward the fall migration period, even at sites where both migrant and resident species occur throughout the summer (Arnett *et al.* 2008, Kunz *et al.* 2007b).

A second group of ultimate hypotheses propose coincidental reasons for mortality, in which certain innate behaviors, such as echolocation or migration, result in increased mortality risk (Cryan and Barclay 2009). Since long-distance migrants are most often killed, it is often assumed that migratory behavior itself is the ultimate cause of mortality. This hypothesis makes sense, although it needs to be tested further, particularly in light of the fact that spring migratory behavior does not result in the same levels of fatality (Arnett *et al.* 2008, Cryan and Barclay 2009). Further, it is unclear whether migration, or other aspects of autumn behavior, is contributing to risk: clustering of migrants (by landscape features which could create migration corridors or stopover habitats, or by certain weather conditions) may make them more vulnerable; migrants may fly higher than residents or use echolocation less often; or seasonal changes in behavior (due to changing energy requirements, mating behavior, or changes in insect distribution, for example) could lead to coincidental increases in risk (Cryan and Barclay 2009).

The final group of ultimate hypotheses propose attraction of bats to wind turbines for various reasons: FAA lighting, sound of blades or generators, blade motion, insect aggregations, habitat modifications favorable for roosting or foraging, turbines viewed as potential roosts, turbines viewed as mating sites (Cryan and Barclay 2009). The only hypothesis that might be discarded at this time is that bats are attracted to FAA required lighting, as many studies have shown no difference in mortality under lit and unlit turbines (Arnett *et al.* 2008, Baerwald 2008, Cryan and Barclay 2009). Thermal images have documented bats foraging near and landing on turbine blades and monopoles, indicating attraction to turbines, possibly due to the sight, sound, or movement of the turbines (Horn *et al*. 2008). Bats may also be attracted to turbines as roosts, since many species favor taller trees as roosts (Kalcounis-Rüppell *et al.* 2005), and fatalities may increase with increasing turbine height (Barclay *et al.* 2007). To date, most insight into attraction hypotheses comes from incidental data, and there are few studies that test these hypotheses directly.

Studies have found that bat collisions with wind turbines are greatest on relatively calm nights (wind speeds less than 4-6 meters per second [m/s]) (Arnett *et al*. 2008). This pattern is reinforced by pre-construction acoustic monitoring of bat activity, which has documented that bat activity was highest on nights with wind speeds of less than 5.4 m/s (Reynolds 2006) as well as more recent curtailment studies conducted in Alberta, Canada, which documented reductions in bat mortality when certain turbines were feathered at wind speeds below 5.5 m/s (Baerwald et al 2009).

In a recent survey of results of post-construction mortality of bats at wind facilities, Kunz *et al.* (2007b) published results of five studies in which acoustic surveys were conducted concurrently with mortality searches (Table 4-8). Although only five studies were available, results suggest a correlation between post-construction bat activity and collision mortality rates. When comparing these survey results, it is important to consider that calls reported in these studies were not categorized by species, indicating that calls may have been from different species than those documented in mortality surveys. Also, certain surveys involved detectors deployed at various heights, potentially influencing detection rates (Kunz *et al.* 2007b). Currently, there are no published reports examining relationships between pre-construction acoustic surveys and post-construction mortality searches (Cryan and Barclay 2009).

Table 4-8. Results of surveys that correlated bat activity rates derived from acoustic surveys to mortality rates, as cited in Kunz *et al.* 2007b

Study Area	Inclusive Dates of Survey	Bat Mortality (no./turbine/yr)	Bat Activity (no./detector/night)	Total Detector Nights	Source
Mountaineer, WV	31 Aug–11 Sep 2004	38.0	38.2	33	E. B. Arnett, Bat International, unpublished
Buffalo Mountain, TN	1 Sep 2000–30 Sep 2003	20.8	23.7	149	Fiedler 2004
Top of Iowa, IA	15 Mar–15 Dec 2003, 2004	10.2	34.9	42	Jain 2005
Buffalo Ridge, MN	15 Mar–15 Nov 2001, 2002	2.2	2.1	216	Johnson et al. 2005
Foote Creek Rim, WY	1 Nov 1998–31 Dec 2000	1.3	2.2	39	Gruver 2002

To date, mortality rates have been highest at wind developments along forested ridges in eastern U.S., particularly in the Mid Atlantic States, with some of the highest estimated mortality occurring at the Mountaineer, WV development (38.0 bats/turbine/year) and Buffalo Mountain, TN development (63.9 bats/turbine/year, Appendix A, Table 9). Post-construction surveys nearer to this Project area, and potentially more relevant, include three seasons of post-construction surveys at Maple Ridge, in Lewis County, New York, a preliminary survey at Lempster, New Hampshire, and two seasons of surveys at the Mars Hill facility in Maine. Currently, the results of the spring season only at Lempster, NH are available (the estimate of the bat mortality rate is currently not available). Only one little brown bat was found at Lempster on May 25, 2009 (Tidhar 2009a) despite the detection of long distance migratory bat species during pre-construction surveys at this site. Estimates of bat mortality among the three years of surveys at Maple Ridge, New York ranged from 8.18 to 20.31 bats per turbine per year (based on the results of daily verses bi-weekly verses weekly searches) (Jain et al. 2007, 2008, 2009a). In 2008, species involved in collisions at Maple Ridge included hoary bats, silver-haired bats, eastern red bats, little brown bats, and big brown bats (Jain et al. 2009a). Estimates of bat mortality among the two years of surveys at Mars Hill ranged from 0.17 to 4.4 bats per turbine per year (based on the results of daily verses weekly verses seasonal dog searches). Species involved with collisions at Mars Hill included silver-haired bat, hoary bat, eastern red bat, and little brown bat (Stantec 2008c and 2009c). The majority of bat fatalities at both the Maple Ridge and Mars Hill facilities were documented from July to September (Jain et al. 2009b, Stantec 2008c and 2009c), consistent with the findings of other mortality studies conducted in the U.S. (Arnett *et al.* 2008).

Measurement endpoint 6a therefore indicates that the likelihood of collision mortality for individual bats as a result of the Project is relatively high (largely related to long-distance migrants), and the magnitude of these impacts should be within the range of collision mortality observed at operational wind facilities located on forested ridgelines (Table 4-9). However, it is expected that collision mortality at the Project will be more similar to projects on forested ridges in New England, which have documented relatively low collision rates, than projects in the mid-Atlantic region, which is geographically less similar. Given the small number of post-construction mortality studies that include detailed information on bats, and the inability to relate literature to site-specific issues, this measurement endpoint has a large degree of uncertainty associated with it.

Table 4-9. Evaluation of risk of impact to bats at the Kingdom Community Wind Project

Assessment Endpoint		Measurement Endpoints		WOE Score	Risk of Impact	Magnitude of Impact	Rationale
6	Potential collision mortality of bats	6a	Literature review	Low/ Medium	Yes	Moderate	Some bats are killed at most wind facilities in northeast, although there are variable rates of mortality at different sites and locations. Impacts occur most often during the fall migratory period, and most often to long-distance migratory species.
		6b	Acoustic Bat Surveys	Low/ Medium	Yes	Low	Presence of bat species indicates potential risk, which is expected to vary by species, although levels of acoustic activity recorded above canopy were relatively low.
7	Potential habitat loss or displacement of bats from the Project area	7a	Literature Review	Low/ Medium	Yes	Low	Removal of roost habitat is likely the greatest potential impact and is not generally outweighed by creation of additional foraging habitat associated with turbine pad clearings. However, wind facilities typically result in relatively small amount of forest clearing.
		7b	Habitat Characterization	Medium	Yes	Low	Forest clearing will affect a relatively small amount of habitat within the Project, although removal of roost trees may impact the quality of bat habitat.
		7c	Eastern small-footed bat habitat assessment	Medium	Yes	Low	No potential day-roost habitat was found in the area, and even if present, it is unlikely that facility construction will impact roosting or foraging areas for this particular species.

While most documented bat fatalities at wind facilities appear to occur during migration, bats are also at risk of collision during the summer. Exposure pathways may be different in the breeding season versus migratory periods, and could be more related to foraging patterns than migrating, flocking, swarming, or mating behavior. Regardless, cumulative impacts of collision mortality during both migration periods and the summer breeding season are a particular concern for bats, as North American species tend to be relatively long-lived, and reproduce very slowly (Barclay and Harder 2003). Very little is known about the population status and trends of most bat species, and assessing the population-wide impacts of collision mortality can only be speculative at this point. Because susceptibility of collision mortality at wind facilities appears to differ by species and guild within the bat community, information regarding collision mortality of various species and guilds within the bat community is presented below.

4.4.2.1.1 Long-distance Migratory Bat Species

Hoary, red, and silver-haired bats, considered long-distance migratory bat species, appear to be at the greatest risk of collision with wind turbines (Arnett *et al.* 2008, Cryan 2003, Kunz et al. 2007a). This can be assumed given the number of recorded mortalities across the U.S., and especially in the east (Kunz et al. 2007a). Current data from mortality surveys to date show fatalities of these species occur at greater levels during fall migration, although mortalities of summer residents have also been observed (Kunz et al. 2007a). Fall migration patterns of hoary bats differs from spring migration patterns, with male and female hoary bats geographically separated until fall migration when mating occurs (Cryan 2003). This pattern led Cryan and Brown (2007) to postulate that migratory species flock at wind turbines during the fall, using these areas to locate potential mates and thus exposing them to higher mortality risk. Many other hypotheses exist regarding the increased mortality of long-distance migrants, and there are currently not enough data to explain why hoary, red, and silver-haired bats are killed in larger numbers than Myotis species and big brown bats. Although this trend has not yet been explained, no data suggest that different patterns should be expected for this Project.

4.4.2.1.2 Tri-colored bats

Tri-colored bats have also been found in large numbers during mortality surveys at wind facilities, with more observed mortalities than silver-haired bats (Kunz *et al*. 2007a). Interestingly, tri-colored bats are not known to migrate long distances between their summer and winter range (Fujita and Kunz 1984), setting them apart from the other three species frequently killed by wind turbines. Lack of long-distance migrations does not necessarily mean that fatalities are not linked to small-scale migration behavior, but it is unknown why small-scale movements would result in high mortality rates in tri-colored bats but not in *Myotis* species. Little research has been conducted on this species' foraging behavior, but it does appear that they are more frequently found over fields, water, and other open areas (Carter *et al*. 1999, van Zyll De Jong 1985). If tri-colored bats do prefer to forage in open areas or above the forest canopy this could potentially explain high mortality rates for this species.

4.4.2.1.3 *Myotis* species

Although *Myotis* species also migrate (Fenton and Barclay 1980, Kurta and Murray 2002), they do so at smaller scales than has been observed among the *Lasiurus* and *Lasionycteris* genera (Cryan 2003). Unlike red bats and hoary bats, North American *Myotis* species hibernate in caves (Whitaker and Hamilton 1998), where copulation occurs prior to hibernation. Unlike the tree-roosting bats, *Myotis* species exhibit swarming behavior, in which they gather in large numbers outside hibernacula during the fall to find mates and copulate prior to entering hibernation. It is unknown whether the difference in migration and mating behavior between *Myotis* species and long-distance migrants is the cause for differing mortality rates, or if differences in mortality rates are the result of differences in other behaviors (i.e., foraging). Regardless, *Myotis* species are likely at lower levels of risk than hoary bats, red bats, and silver-haired bats based on post-construction surveys (Kunz *et al*. 2007a). Despite their abundance, *Myotis* species have comprised only 6.2 percent of documented bat fatalities across the US, and only two species have been documented during mortality surveys (little brown and northern long-eared) (Kunz *et al*. 2007a).

To date, no publicly available post-construction mortality surveys have documented fatalities of eastern small-footed bat at wind energy facilities (Kunz *et al.* 2007a). Although no mortalities have been observed, there is some uncertainly regarding the collision risk of this species. First, large mortality rates across the species' range should not be expected since the eastern small-footed bat is uncommon and is believed to migrate very small distances (Best and Jennings 1997, Johnson and Gates 2007). These two factors suggest that exposure to wind turbines is likely limited across the species' range. Additionally, the species' small size potentially makes finding carcasses during post construction mortality surveys more difficult than finding larger, more noticeable species.

4.4.2.1.4 Big Brown Bats

Although big brown bats are abundant throughout the northeast, they have made up only 2.4 percent of total mortalities at wind developments across the U.S., indicating that their risk of impact is comparable to that of little brown and northern myotis species, and is suspected to be low, relative to migratory tree bats and tri-colored bats (Kunz *et al.* 2007a). Big brown bats are known for their ability to navigate using the Earth's magnetic field (Holland *et al*. 2006). However, they are not known to migrate distances comparable to hoary, red, and silver-haired bats, although movements of up to 228 km have been recorded (Mumford 1958). Big brown bats are relatively large and are strong fliers, suggesting that they may be more inclined to fly in open spaces or at higher altitudes than *Myotis* species.

4.4.2.2 Acoustic Bat Surveys (Measurement Endpoint 6b)

Five acoustic detectors were deployed by Stantec in three locations along the Project area ridgeline. A total of 10,130 call sequences were recorded over a period of 856 detector-nights between April 16, 2009 and October 18, 2009 (11.8 call sequences per detector-night). Activity increased steadily in the spring, peaked in July at all but one detector (which peaked in June), and then declined steadily through October. Twenty-one percent of all recorded call sequences belonged to the big brown/silver-haired bat (BBSH) guild, 18 percent were assigned to the *Myotis* guild, and less than 1 percent of calls were assigned to the red bat/tri-colored bat (RBTB) guild and the hoary bat guild. Remaining calls were assigned to the Unknown guild. A detailed description of the survey design, methods, and results of this survey is included in Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont (Stantec 2009a).

As is often observed in acoustic bat surveys, species composition differed between ground-level detectors and portable tower detectors during 2009 surveys, with *Myotis* species being detected far more frequently near the ground than above the forest canopy. Notably, silver-haired bats were detected relatively frequently during 2009 acoustic surveys, with silver-haired bat call sequences comprising 83% of calls in the BBSH guild, and 17% of total calls recorded. Silver-haired bat activity was very pulsed throughout the survey, with peaks in activity occurring at disparate times between mid June and mid August. The maximum number of silver-haired bat calls per night was recorded on June 15 (Stantec 2009a).

There are few datasets from Vermont with which to compare these results. One nearby project in Sheffield, VT (approximately 20 miles southeast of the Project), has publicly available data on pre-construction acoustic surveys conducted there (Table 4-10; also see Appendix A, Tables 1 and 11for additional publicly available data from spring and fall surveys in New England and New York). However, none of the surveys conducted at Sheffield collected data during July, when 56% of call sequences were recorded at the Project. Further differences in detector height above ground level, habitat variability surrounding detectors, and year-to-year variation in activity all contribute to variable detection rates between projects.

Table 4-10. Summary of bat detector surveys at Sheffield and Kingdom Community Wind Projects (results reported for individual detectors)

Year	Project	Project Location	Height (m)	Detector Nights	Start	End	Calls	Rate	Reference
2004	Sheffield	Sheffield, Caledonia Cty, VT	15	6	9/10	9/15	30	0.23	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2004	Sheffield	Sheffield, Caledonia Cty, VT	30	5	10/17	10/21	0	0	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2005	Sheffield	Sheffield, Caledonia Cty, VT	10	4	5/12	5/29	0	0	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2005	Sheffield	Sheffield, Caledonia Cty, VT	20	31	5/1	5/31	6	0.2	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2006	Sheffield	Sheffield, Caledonia Cty, VT	8	38	4/24	6/13	840	22.1	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2006	Sheffield	Sheffield, Caledonia Cty, VT	9	37	4/24	6/13	90	2.4	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2006	Sheffield	Sheffield, Caledonia Cty, VT	8	34	4/24	6/13	178	5.2	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2006	Sheffield	Sheffield, Caledonia Cty, VT	30	36	4/24	6/13	5	0.14	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2009	Kingdom	Lowell, Orleans Cty, VT	1.5	173	4/17	10/18	404	2.3	Stantec Consulting, Inc. 2009. Bird and Bat Assessments for Kingdom Community Wind Project in Lowell, Vermont. Prepared for Vermont Environmental Research Associates.
2009	Kingdom	Lowell, Orleans Cty, VT	2	142	4/16	10/18	5010	35.3	Stantec Consulting, Inc. 2009. Bird and Bat Assessments for Kingdom Community Wind Project in Lowell, Vermont. Prepared for Vermont Environmental Research Associates.
2009	Kingdom	Lowell, Orleans Cty, VT	10	186	4/16	10/18	90	8.2	Stantec Consulting, Inc. 2009. Bird and Bat Assessments for Kingdom Community Wind Project in Lowell, Vermont. Prepared for Vermont Environmental Research Associates.
2009	Kingdom	Lowell, Orleans Cty, VT	15	185	4/17	10/18	1924	10.4	Stantec Consulting, Inc. 2009. Bird and Bat Assessments for Kingdom Community Wind Project in Lowell, Vermont. Prepared for Vermont Environmental Research Associates.
2009	Kingdom	Lowell, Orleans Cty, VT	15	170	4/16	10/18	1270	7.5	Stantec Consulting, Inc. 2009. Bird and Bat Assessments for Kingdom Community Wind Project in Lowell, Vermont. Prepared for Vermont Environmental Research Associates.

This comparison illustrates some of the problems with comparing results of acoustic data surveys, and in fact, direct comparison of acoustic activity levels between sites is not necessarily a valid means of assessing potential risk to bats. Variation in detection rates is typical for results of acoustic surveys due to a variety of factors: bat species are not all equally-detectable at equal distances from the unit; differences in surrounding noise clutter leads to differences in a unit's range of detection; spatial variation in activity can be very high across a site (horizontal variation); spatial variation in activity can be vary with height above ground (vertical variation); and bat activity is variable within and across nights (Hayes 1997, Hayes 2000). Passive monitoring throughout the night and throughout the active season accounts for some factors, but ultimately there are limits to the inferences that can be made using indices of activity because most of these factors cannot be controlled between sites.

Further, the ultimate cause of bat mortality has implications as to the relevance of acoustic activity indices collected during pre-construction surveys (see discussion of ultimate hypotheses in section 4.4.2.1). If bat fatalities are a random event, then monitoring general pre-construction activity can be used as a means of assessing risk, because fatalities should be correlated with general species composition and timing of activity in the area. If collision fatalities are due to coincidental behaviors, then species composition data collected during pre-construction may be informative as they identify species present and therefore at risk; however, activity patterns may not relate to timing of risk if behaviors present at certain times of the year are driving risk exposure. Finally, if bats are attracted to turbines, then pre-construction species composition and patterns of activity could change once turbines are constructed (Cryan and Barclay 2009).

Regardless, acoustic sampling of bat activity has become a standard aspect of pre-construction surveys for proposed wind-energy developments (Kunz *et al.* 2007a, 2007b), and remains the only way to collect simultaneous data at multiple locations, at varying heights above ground level, and across long periods of time. Acoustic surveys represent the best available methodology at this time for determining baseline activity levels and general species composition. Although activity level, in the form of number of call files recorded, does not equate to the number of individuals at a site (Hayes 2000), it is commonly assumed that higher levels of activity occur when more bats are present, and lower levels of activity occur when fewer bats are present (see Hayes 2000 for a discussion of this assumption and associated limitations). In the Project area, activity levels were highest in July (Stantec 2009a). If level of activity is assumed to correlate with number of individuals in the area, and if collision is assumed to be a random event and thus associated with the individuals present in the area (see Cryan and Barclay 2009 and discussion in section 4.4.2.1), then risk of collision mortality would be expected to be greatest during July. However, if collision mortality is assumed to be coincidentally associated with migration (see Cryan and Barclay 2009 and discussion in section 4.4.2.1), then risk of collision may peak later, during the fall migratory period. Given these same assumptions, risk of collision mortality should be greatest for long-distance migrants, as the species composition at the detectors deployed highest above ground was skewed toward detecting silver-haired bats.

Overall, this measurement endpoint indicates a potential for collision mortality based on comparison to other sites (Table 4-9). Potential impacts are expected to vary by season, following patterns observed at other operational wind facilities, particularly those in New

England. At New England facilities impacts have been greatest during the fall migration period but overall have been relatively low (see Appendix A, Table 9). Potential impacts are also expected to vary by species, due to behavioral factors, relative abundance, and documented patterns in collision mortality, as discussed below.

4.4.2.2.1 Long-distance Migratory Bat Species

Hoary, red, and silver-haired bats were all documented during acoustic surveys, indicating the presence of each species within the Project area. The number of silver-haired bat call sequences (n = 1,721) far exceeded the number of hoary bat (n = 4) and red bat (n = 10) call sequences, although inferences on abundance should not be made based on acoustic indices. However, the activity pattern for silver-haired bats (Figure 4-1) does indicate that activity occurred primarily over June and July, and was negligible after August. As fall migration of long-distance migrants is thought to occur between August and September (Cryan 2003), this may indicate that silver-haired bats in the area are residents and not migrants.

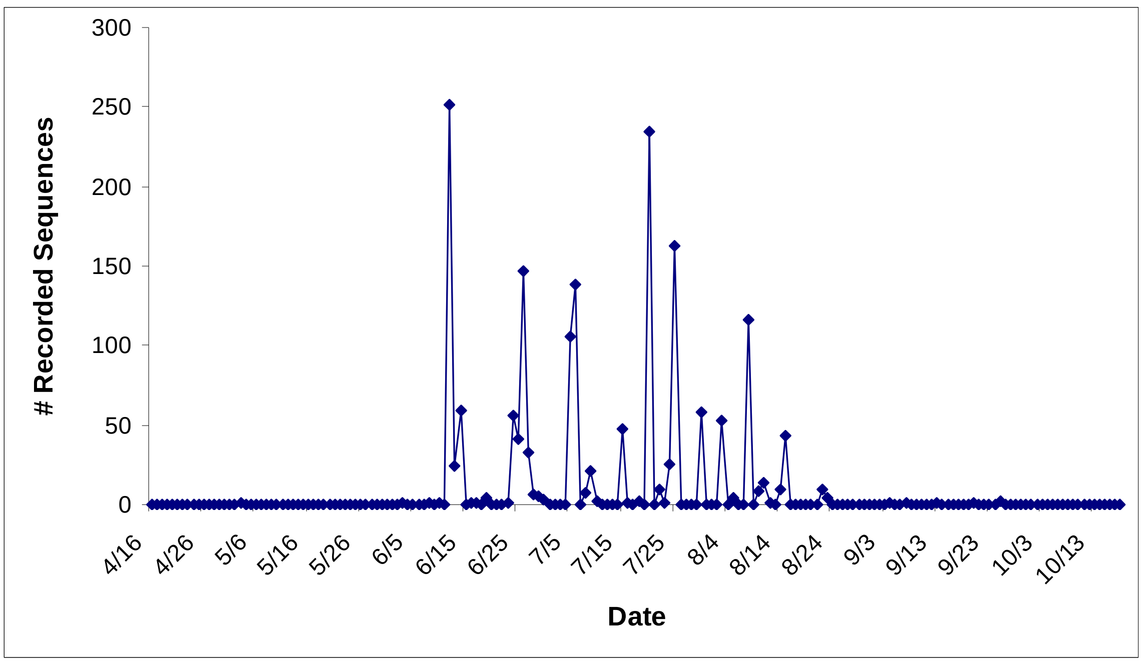

Figure 4-1. Silver-haired bat activity, measured as the number of nightly call files recorded, at Kingdom Community Wind, 2009.

Long-distance migrant species were recorded more often at detectors deployed at or above tree canopy height than were *Myotis* species, supporting the observation that these species tend to fly higher than other species, which may contribute to a greater risk of collision mortality (Cryan and Brown 2007, Kunz *et al*. 2007a). The biology of these species, their presence at the Project area, and known post-construction mortality trends suggests that long-distance migrants are more vulnerable to collision mortality at the Project than other bat species.

If collision mortality is coincidentally associated with migration, and if long-distance migrants in the area show activity patterns similar to silver-haired bat activity in 2009, then mortality of long-distance migrants at the Project may be lower than that observed at facilities further south, because these species may not be migrating through the Project area at the levels seen elsewhere since little to no activity of long-distance migrants was observed during the majority of the fall migration period (August and September). If collision mortality is random, then long-distance migrants may be at risk earlier in the migratory period than observed at other facilities, since activity and therefore presence occurred primarily during the summer months. If likelihood of collision mortality is increased due to an attractant quality of wind energy facilities, then mortality of long-distance migrants will likely be similar to that at other facilities. Thus, given the ecology of long-distance migrants, mortality will likely occur; overall mortality will likely be low, as has been observed at other New England projects; and mortality will likely be during the fall migratory period, as has been observed at other New England facilities, although it may occur earlier due to the early departure of long-distance migrants from northerly locations.

4.4.2.2.2 Tri-colored bats

Tri-colored bats were not documented directly during acoustic surveys. This does not preclude their presence in the Project area, since there were 5 call sequences identified only as belonging to the RBTB guild, meaning that the files could not be further distinguished as either tri-colored bat or red bat. Available post-construction data suggest that this species is among those more vulnerable to collision mortality (Kunz *et al.* 2007a), suggesting potential risk for collision mortality at this Project if they are present.

4.4.2.2.3 *Myotis* species

Myotis species were documented at each detector, particularly at the ground-level detectors. Although expected to be the most common group of bats within the Project area during much of the summer and fall, *Myotis* species tend to be active below the forest canopy (Arnett *et al.* 2006). Therefore, despite their likely prevalence, these species may be at a lower risk of collision mortality than other less common species.

4.4.2.2.4 Big Brown Bats

Big brown bats were documented during acoustic surveys in 2009, indicating their presence in the Project area. Only one call file was identified specifically as a big brown bat; however, files identified as belonging to the BBSH guild were identified at all detectors. The results of post-construction surveys suggest risk to this species is low despite activity above the forest canopy (Kunz *et al*. 2007a).

4.4.3 Indirect Impacts to Bats (Assessment Endpoint 7)

4.4.3.1 Literature Review (Measurement Endpoint 7a)

In addition to direct collision mortality, the construction of wind energy facilities has the potential to cause indirect impacts such as habitat loss, habitat conversion, and displacement of bats.

Although no studies have measured the response of existing bat communities to the creation of a wind facility and its associated infrastructure, several effects could be expected.

If existing forest stands were removed during the creation of access roads and turbine pads, available roosting habitat could be reduced. The magnitude of impact on local bat communities would vary based on the quality and quantity of habitat removed and the availability of alternate habitat of comparable quality and character. For example, removal of large diameter dead and declining trees of many species would constitute removal of high quality roosting habitat. Additionally, if the habitat conversion lowered the overall habitat diversity of an area, it could negatively affect the bat community (Hayes and Loeb 2007). The duration of the impact would vary depending on whether the original habitat was allowed to revert to its pre-construction condition or whether the habitat would be permanently lost. Long-term loss of habitat would be incurred where the forest was cleared for turbine placement, thus preventing recruitment of potential snags for the near future.

In some cases, conversion from forested to non-forest habitat could result in short or long-term benefits to local bat communities, depending upon the configuration of the surrounding forested landscape. For example, forest gaps and clearings create additional foraging opportunities, as documented by higher levels of bat activity in fields, edges, and clearings (Hayes and Loeb 2007). This apparent enhancement of foraging habitat is possibly a function of reduction in clutter rather than enhancement of insect (prey) habitat. Depending on the size, plant species composition and diversity, and surrounding habitats, fields have been shown to produce lower insect diversity and abundances, but may still be close enough to forest habitat to still maintain insect levels suitable for bat foraging (Burford *et al*. 1999, Dodd 2006). Creation of forest gaps and clearing has been recommended as a management technique for some species (Krusic *et al*. 1996), but not all bat species in the eastern U.S. would benefit from such practices (Owen *et al*. 2003). However, foraging habitat is typically present in far greater abundance than roosting habitat, and therefore any potential increase in foraging habitat would not offset potential loss of roosting habitat if suitable trees/stands are removed during construction.

Overall, the literature review indicates the potential for indirect impacts to bats, from removal of roost trees, creation of edge habitat, and construction of wind turbines, which may affect the distribution and movement patterns of bats in an area. Results from other wind projects and general understanding of how bats utilize habitat suggest that the creation of edge habitat and clearing associated with the Project will likely cause a shift in bat activity patterns along the ridgeline, increasing the amount of foraging habitat, and possibly creating flight corridors along the ridgeline. While some of these impacts are not necessarily harmful to bats, the Project may influence the distribution and possibly species composition of bats within the Project (Table 4-9). Overall, measurement endpoint 7a indicates a low potential for habitat loss or displacement (Table 4-9).

4.4.3.2 Habitat Characterization (Measurement Endpoint 7b)

The Project area is primarily forested, yet includes flight corridors, forest gaps, water sources, and diverse roosting potential. Flight corridors are typically linear features which offer natural flight paths for navigation and low-clutter foraging habitat (Hayes and Loeb 2007, Lacki *et al*.

2007), and occur as forest roads, timber harvesting clearings, and access roads. Forest gaps are also important, and have been shown to have higher levels of bat activity than surrounding habitat in several studies (Hayes and Loeb 2007, Lacki *et al*. 2007, Menzel *et al*. 2002, Tibbels and Kurta 2003). Forest gaps at the Project occur primarily as timber harvest clearings and larger blow-down areas along the ridgeline; the clearing for a previously-used met tower also created a forest gap. Bat species in the Project area are expected to primarily utilize live and dead trees as summer day-roosts, as roosting opportunities in buildings and rock-structures seem to be limited.

Creation of cleared areas for turbines and project infrastructure will result in the development of some additional edge habitat within forested stands and may result in an increase in the amount of available foraging habitat for bats. However, clearing of forest associated with turbines and infrastructure may potentially remove roosting habitat for some species, although this also currently occurs as a result of timber harvests. Because foraging habitat is abundant within the Project area, roosting habitat is a more likely limiting factor for local bat species. Generally speaking, ridgetop habitat contains fewer open water wetlands, shorter tree canopy height, and generally harsher conditions than are present at lower elevations within the Project area making this habitat less suitable for roosting. Because tree clearing associated with the Project will primarily affect ridge-top habitats, and because the amount of tree removal will be minimal in comparison to the amount of available habitat, indirect impacts to bats as a result of habitat removal are expected to be minor. Bats are expected to roost where habitat is suitable and forage along the edges of turbine access roads and clearings, as they currently do along edges of existing timber harvesting roads and cleared areas.

4.4.3.3 Eastern Small-footed Bat Habitat Assessment (Measurement Endpoint 7c)

The eastern small-footed bat is a state threatened species in Vermont. A remote assessment with a follow-up site visit was used to determine whether there was any potential eastern small-footed bat day-roost habitat within 3 miles of the Project area. Three characteristics of what is thought to be the most suitable habitat for day-roosts – (1) steep slopes, (2) visible rock formations, and (3) southerly aspect – were used to identify potential roosting locations. No areas were identified as potential habitat during the remote assessment or during a follow-up site visit. A detailed description of the survey design, methods, and results of this survey is included in Bird and Bat Surveys for Kingdom Community Wind Project in Lowell, Vermont (Stantec 2009a).

Remote assessments such as this one provide a way of efficiently locating characteristic landscape qualities to identify what is thought to be high quality eastern small-footed bat habitat. However, this approach has pitfalls: course landscape measurements may miss finer-scale locations that could be considered potential roosting habitat; and although rocky outcrops are considered the most suitable roosting habitat, eastern small-footed bats can roost in other man-made structures and smaller rocky areas. General characteristics of the topography surrounding the Project area (rolling hills with gradual changes in topography, no steep slopes observed) did not indicate many opportunities for day-roosts in steep talus slopes. However, presence or absence of the species cannot be definitively determined based on these methods.

If day-roost habitat is limited in and around the Project area, then it is likely that eastern small-footed bats are not present, or are present in very low numbers. It is unlikely that construction of a wind energy facility will remove day-roosting opportunities for eastern small-footed bats. Similar to other bat species in the area, the removal of existing forest stands during the creation of access roads and turbine pads may increase forest edges and corridors used for foraging. The maximum elevations at which eastern small-footed bats forage is unknown, although generalizations of ridgetop habitat (fewer open water wetlands, shorter tree canopy height, and harsher conditions than are present at lower elevations) seem to make ridgetop areas less suitable for foraging. Foraging opportunities may increase on the lower slopes as access roads are created, although several roads already exist. Therefore, indirect impacts to eastern small-footed bats as a result of facility construction are expected to be low.

4.4.4 Conclusions

Potential impacts to bats are expected to be low to moderate. Results from post-construction surveys at existing facilities indicated that potential impacts to bats consist largely of collision mortality. While collision mortality has been documented at operational wind facilities during summer, and bats likely reside within the Project area between early spring and late fall, bats seem most vulnerable to collision during the fall migration period, based on regional post-construction results. Long-distance migratory bat species have comprised the majority of fatalities at most operational facilities in the Northeast, although there is variability in rates of mortality and species composition at different sites. On-site acoustic surveys documented presence of bat species or species groups typical to the area. Silver-haired bats (*Lasionycteris noctivagans*), one of three long-distance migratory species found in Vermont, were well represented in the results of on-site acoustic surveys, particularly at detectors surveying airspace at or above tree canopy. Therefore, literature review and acoustic surveys both indicated a potential for direct impacts, since some bats are killed at most wind facilities in the Northeast and presence of bat species indicates potential risk, although low overall rates of acoustic activity above tree canopy may indicate a low magnitude of direct impacts.

Literature review and habitat assessments both indicated a potential for indirect impacts, as removal of roost habitat is likely not outweighed by creation of additional foraging habitat associated with turbine pad clearings. However, the magnitude of indirect impacts is expected to be low, given the relatively low amount of anticipated clearing, the large forest blocks surrounding the Project area that could compensate for roosting habitat lost during clearing, and the currently disturbed nature of some habitats within the Project area as a result of current timber harvest activities.

All measurement endpoints used to assess potential direct and indirect impacts to bats predicted that impacts will occur. Impacts are expected to be greatest during the late summer and early fall migratory season, and to long-distance migratory bat species, based on the timing of acoustic activity at the Project as well as patterns observed at operational sites in the eastern U.S., including sites in New England. Patterns of collision mortality are expected to be most similar to operational projects in New England, where topography and habitat are most similar to the Project, and where low levels of bat mortality have been documented.

The various endpoints used to assess risk to bats at the Project each focused on a specific source of data and thus provided slightly different information. With respect to potential collision mortality (assessment endpoint 6), literature review (measurement endpoint 6a) indicated a potential for impacts with moderate magnitude, and acoustic surveys (measurement endpoint 6b) predicted a risk of impact with low magnitude. For the assessment endpoint 7 (potential habitat loss or displacement of bats), literature review (measurement endpoint 7a) predicted potential impacts with low magnitude, habitat characterization (measurement endpoint 7b) predicted potential impacts with low magnitude, and the eastern small-footed bat habitat assessment (measurement endpoint 7c) predicted impacts to eastern small-footed bats, if present, with low magnitude. Thus, five measurement endpoints predicted some level of risk to bats associated with the Project (Table 4-11).

Table 4-11. Concurrence among measurement endpoints for bats at the Kingdom Community Wind Project.

Increasing Evidence of Risk	**Evidence of Impact?/ Magnitude?**	**Weighting Factors**				
		Low	**Low/ Medium**	**Medium**	**Medium/ High**	**High**
	Yes / High					
	Yes / Moderate		**6a**			
	Yes / Low		**6b, 7a**	**7b, 7c**		
	No					
	Undetermined					
	Increasing Confidence or Weight					

6a	Literature Review (Potential collision mortality)
6b	Acoustic Bat Surveys (Potential collision mortality)
7a	Literature Review (Potential habitat loss or displacement)
7b	Habitat characterization (Potential habitat loss or displacement)
7c	Small-footed bat habitat assessment (Potential habitat loss or displacement)

5.0 Summary and Conclusions

High evidence of impact was not found for any group of species examined in this document. Raptors and breeding birds will likely have a low risk of impact. On-site surveys documented typical species assemblages, abundances, or passage rates for raptors and breeding birds. Data from existing facilities outside of California suggests that raptors are generally not vulnerable to direct impacts associated with collision mortality, or indirect impacts associated with habitat modification. Collision mortality of breeding birds has been documented at low rates at existing facilities, and while habitat modification is expected to result in shifts in species distribution and abundance for some species, a history of forest disturbance and a high proportion of edge-associated species will likely result in low overall indirect impacts to this group.

Direct impacts in the form of collision mortality are expected for nocturnally migrating passerines and bats, with impacts occurring primarily during the fall migration period. Collision mortality of nocturnally migrating passerines occurs at most wind facilities; however, impacts are expected to be low given the high percentage of individuals at the Project area flying well above the proposed turbine height, and regional post-construction surveys where mortality has been relatively low. Potential impacts to bats are expected to be low to moderate. Bats are killed at most wind facilities in the northeast, and long life spans and low reproductive rates make bats particularly vulnerable to impacts. Although presence of bat species at the Project presumably indicates potential risk, little is known about the behaviors and mechanisms of collision for bats, and variable mortality rates have been documented at different sites. Impacts to bats are expected to be greatest during the late summer and early fall migratory season, and to long-distance migratory bat species, given the timing of acoustic activity at the Project as well as patterns observed at operational sites in the eastern U.S.

Potential impacts to threatened and endangered species range from none to low, depending on the species. No state or federal threatened or endangered breeding bird species was observed during breeding bird surveys. One bald eagle (state endangered species) was observed during raptor surveys, but the observation was outside the project area, and no bald eagles were observed during breeding bird surveys. Furthermore, raptors as a group are expected to experience low direct and indirect impacts given their low rates of collision mortality, high rates of turbine avoidance behavior, and the small amount of land clearing for the Project in comparison to the amount of surrounding habitat. The Indiana bat is the only endangered bat species in Vermont, and its range does not include the Project area. The small-footed bat is state listed as threatened, and its known range does include the Project area. No potential roosting sites were identified during the remote habitat analysis, so it is unlikely that there will be an impact to roost habitat for this species. Therefore, potential impacts are not anticipated for certain endangered species such as the Indiana bat, and are expected to be unlikely and minor for other endangered or threatened species such as the bald eagle and small-footed bat.

Overall, the impacts to birds and bats expected at the Kingdom Community Wind Project are not unique to this Project, and are expected to be similar to those at other projects located in areas with similar habitat and topography. Existing facilities in New England, where topography and habitat are most similar to the Project area, have documented low levels of nocturnally migrating passerine and bat mortality relative to facilities outside of New England.

This document attempts to make the most appropriate use of a combination of data sources ranging from on-site field surveys to regional databases to literature reviews, to assess potential impacts to birds and bats associated with construction of a wind energy facility on the Lowell Mountain range in Vermont. The WOE approach provides a means to use available data to the extent that it can be used to predict risk of direct and indirect impacts to birds and bats. While the predictions made in this assessment contain uncertainty, additional pre-construction data would not necessarily facilitate more accurate predictions of risk to birds and bats. At present, no pre-construction survey technique allows for quantitative prediction of risk to bird and bats, given the complexity of ecological, climatic, seasonal, and behavioral factors that likely play roles in influencing rates of direct and indirect impacts to bird and bat resources. The primary difficulties encountered in predicting risk of collision mortality and indirect impacts associated with wind facilities include the lack of understanding of factors causing birds and bats to collide with wind turbines, the influence site location may play on collision factors, and the inadequately established relationship between pre-construction and post-construction survey results.

When viewed together, all assessment and measurement endpoint pairs indicate that potential impacts will occur, and most indicate that the magnitude of impacts will be low (Table 5-1). One endpoint (literature review) suggested moderate magnitudes of impact to migratory bats. High evidence of impact was not found for any species group. As described in the preceding sections, risk of impacts for each group will vary by time of year, conditions, species, season, and presumably by particular aspects of the site. The results of this weight-of-evidence process provide a thorough summary of the current understanding of potential risks to the species groups evaluated.

Table 5-1. Concurrence among measurement endpoints for raptors, nocturnally migrating passerines, breeding birds, and bats at the Kingdom Community Wind Project

Increasing Evidence of Risk	Evidence of Impact?/ Magnitude?	Weighting Factors				
		Low	**Low/ Medium**	**Medium**	**Medium/ High**	**High**
	Yes / High					
	Yes / Moderate		**6a**			
	Yes / Low		**1a, 2a, 3a, 4a, 6b, 7a**	**2b, 3b, 5a, 5b, 7b, 7c**	**1b, 4b**	
	No					
	Undetermined					
	Increasing Confidence or Weight					

1a	Literature Review (Potential collision mortality of raptors)
1b	On-site and regional Raptor Migration Surveys (Potential collision mortality of raptors)
2a	Literature Review (Indirect impacts to raptors)
2b	Habitat Characterization (Indirect impacts to raptors)
3a	Literature Review (Potential collision mortality of nocturnally migrating passerines)
3b	On-site Radar Surveys (Potential collision mortality of nocturnally migrating passeries)
4a	Literature Review (Potential collision mortality of breeding birds)
4b	On-site and Regional Bird Surveys (Potential collision morality of breeding birds)
5a	Literature Review (Indirect impacts to breeding birds)
5b	Habitat Characterization (Indirect impacts to breeding birds)
6a	Literature Review (Potential collision mortality of bats)
6b	Acoustic Bat Surveys (Potential collision morality of bats)
7a	Literature Review (Potential habitat loss or displacement of bats)
7b	Habitat characterization (Potential habitat loss or displacement of bats)
7c	Small-footed bat habitat assessment (Potential habitat loss or displacement)

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Appendix A

Bird and Bat Data Tables

Appendix A Table 1. Breeding Bird Survey Data from the Hardwick, Vermont survey route, 1999 through 2009

Common name	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Canada Goose	0	-	-	-	0	7	1	0	0	-	0	8
Wood Duck	1	-	-	-	0	0	0	0	0	-	0	1
Mallard	1	-	-	-	0	0	0	0	0	-	0	1
Ruffed Grouse	0	-	-	-	1	0	2	0	0	-	0	3
Wild Turkey	0	-	-	-	0	0	0	0	1	-	0	1
Common Loon	1	-	-	-	1	0	0	0	1	-	1	4
American Bittern	0	-	-	-	0	0	0	2	2	-	0	4
Great Blue Heron	0	-	-	-	0	0	0	1	0	-	0	1
American Kestrel	4	-	-	-	0	0	0	0	0	-	0	4
Killdeer	1	-	-	-	1	0	3	1	1	-	0	7
Wilson's Snipe	4	-	-	-	3	2	3	0	3	-	6	21
Rock Pigeon	0	-	-	-	0	0	0	2	1	-	0	3
Mourning Dove	5	-	-	-	7	7	10	14	3	-	3	49
Black-billed Cuckoo	0	-	-	-	1	0	0	0	0	-	0	1
Ruby-throated Hummingbird	1	-	-	-	0	1	0	1	0	-	0	3
Belted Kingfisher	5	-	-	-	1	0	1	0	0	-	0	7
Yellow-bellied Sapsucker	1	-	-	-	7	2	13	10	1	-	2	36
Downy Woodpecker	1	-	-	-	0	0	0	1	1	-	2	5
Hairy Woodpecker	0	-	-	-	0	2	2	0	1	-	3	8
Northern Flicker	2	-	-	-	3	0	0	0	0	-	2	7
Pileated Woodpecker	0	-	-	-	1	0	0	1	1	-	1	4
Olive-sided Flycatcher	0	-	-	-	0	1	0	0	0	-	1	2
Eastern Wood-Pewee	1	-	-	-	0	0	0	1	0	-	3	5
Yellow-bellied Flycatcher	0	-	-	-	0	1	0	0	0	-	0	1
Alder Flycatcher	0	-	-	-	24	18	24	15	35	-	25	141
Willow Flycatcher	1	-	-	-	1	2	0	1	0	-	0	5
Least Flycatcher	2	-	-	-	10	8	15	12	6	-	11	64
Eastern Phoebe	8	-	-	-	1	1	7	10	2	-	10	39
Great Crested Flycatcher	0	-	-	-	3	3	5	0	4	-	2	17
Eastern Kingbird	7	-	-	-	7	1	3	0	4	-	1	23
Blue-headed Vireo	2	-	-	-	4	3	2	3	8	-	8	30
Warbling Vireo	0	-	-	-	5	7	6	5	6	-	5	34
Red-eyed Vireo	34	-	-	-	32	41	33	62	44	-	42	288
Blue Jay	12	-	-	-	11	10	20	10	11	-	14	88
American Crow	47	-	-	-	21	30	17	19	15	-	13	162
Common Raven	0	-	-	-	9	7	4	1	1	-	1	23
Tree Swallow	2	-	-	-	7	13	0	6	10	-	4	42
Bank Swallow	8	-	-	-	0	0	9	0	0	-	1	18
Barn Swallow	31	-	-	-	12	6	6	2	3	-	0	60
Black-capped Chickadee	27	-	-	-	23	26	25	29	15	-	34	179
Tufted Titmouse	0	-	-	-	0	0	1	0	0	-	0	1
Red-breasted Nuthatch	1	-	-	-	0	2	2	6	0	-	3	14
White-breasted Nuthatch	0	-	-	-	0	4	2	2	0	-	0	8
Brown Creeper	0	-	-	-	1	0	0	0	0	-	0	1
House Wren	0	-	-	-	0	2	0	1	1	-	5	9
Winter Wren	10	-	-	-	3	2	2	8	3	-	4	32
Golden-crowned Kinglet	0	-	-	-	0	0	0	0	1	-	1	2
Blue-gray Gnatcatcher	1	-	-	-	0	0	0	0	0	-	0	1
Eastern Bluebird	2	-	-	-	3	3	1	1	0	-	0	10
Veery	11	-	-	-	17	21	23	20	21	-	14	127
Hermit Thrush	17	-	-	-	1	4	6	10	1	-	6	45
Wood Thrush	9	-	-	-	7	5	5	2	2	-	1	31
American Robin	60	-	-	-	62	56	48	52	27	-	31	336
Gray Catbird	2	-	-	-	4	1	4	4	2	-	5	22
Brown Thrasher	0	-	-	-	2	0	0	0	0	-	1	3
European Starling	35	-	-	-	53	28	20	7	12	-	51	206
Cedar Waxwing	8	-	-	-	17	22	14	15	10	-	26	112
Nashville Warbler	0	-	-	-	2	1	6	3	3	-	0	15
Northern Parula	6	-	-	-	1	4	3	5	6	-	3	28
Yellow Warbler	3	-	-	-	23	18	8	8	18	-	7	85
Chestnut-sided Warbler	1	-	-	-	6	16	17	11	16	-	15	82
Magnolia Warbler	0	-	-	-	1	3	0	6	1	-	0	11
Black-throated Blue Warbler	0	-	-	-	3	8	8	8	5	-	3	35
Yellow-rumped Warbler	5	-	-	-	2	10	5	5	5	-	2	34
Black-throated Green Warbler	1	-	-	-	3	7	8	8	9	-	4	40
Blackburnian Warbler	0	-	-	-	5	3	7	0	0	-	7	22
Pine Warbler	0	-	-	-	1	0	1	1	0	-	0	3
Black-and-white Warbler	5	-	-	-	9	13	7	19	15	-	7	75
American Redstart	0	-	-	-	9	3	14	11	11	-	18	66
Ovenbird	6	-	-	-	12	12	21	16	16	-	13	96
Northern Waterthrush	0	-	-	-	6	7	6	1	4	-	2	26
Mourning Warbler	0	-	-	-	1	2	2	0	1	-	3	9
Common Yellowthroat	21	-	-	-	42	35	42	40	48	-	36	264
Canada Warbler	0	-	-	-	2	1	1	1	0	-	0	5
Scarlet Tanager	1	-	-	-	1	3	3	6	1	-	1	16
Eastern Towhee	0	-	-	-	0	0	1	0	0	-	0	1
Chipping Sparrow	17	-	-	-	11	20	14	11	14	-	19	106
Savannah Sparrow	5	-	-	-	8	3	6	8	6	-	13	49
Song Sparrow	43	-	-	-	24	36	37	55	29	-	30	254
Swamp Sparrow	11	-	-	-	4	6	2	10	5	-	7	45
White-throated Sparrow	8	-	-	-	10	6	16	16	18	-	7	81
Dark-eyed Junco	2	-	-	-	0	2	3	1	1	-	2	11
Northern Cardinal	0	-	-	-	0	1	0	0	1	-	0	2
Rose-breasted Grosbeak	14	-	-	-	1	0	1	1	4	-	1	22
Indigo Bunting	0	-	-	-	4	4	1	7	6	-	3	25
Bobolink	8	-	-	-	10	5	6	3	10	-	4	46
Red-winged Blackbird	52	-	-	-	64	55	50	59	53	-	48	381
Eastern Meadowlark	4	-	-	-	0	5	0	0	0	-	2	11
Common Grackle	74	-	-	-	27	16	9	0	15	-	6	147
Brown-headed Cowbird	1	-	-	-	3	4	5	0	6	-	0	19
Baltimore Oriole	8	-	-	-	0	0	0	0	4	-	0	12
Purple Finch	0	-	-	-	0	1	0	0	0	-	2	3
American Goldfinch	13	-	-	-	28	15	21	23	25	-	32	157
Evening Grosbeak	2	-	-	-	0	0	0	2	0	-	0	4
House Sparrow	9	-	-	-	12	4	1	6	1	-	6	39
Total Species	61	0	0	0	67	68	66	64	66	0	65	avg: 65.2
Total Individuals	685	0	0	0	701	678	671	688	617	0	646	avg: 669.4

Appendix A Table 2. Breeding Bird Survey Data from the Greensboro, Vermont survey route, 1999 through 2009

Common name	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**Total**
Canada Goose	0	0	0	0	0	0	0	14	0	0	-	14
Mallard	1	0	0	0	1	0	1	4	0	1	-	8
Hooded Merganser	0	0	0	0	0	1	0	0	0	0	-	1
Common Merganser	1	0	0	2	0	0	2	1	0	1	-	7
Wild Turkey	0	0	7	1	0	0	0	0	0	0	-	8
Common Loon	0	1	0	0	0	0	0	1	0	0	-	2
Pied-billed Grebe	0	0	0	0	0	0	0	0	1	0	-	1
American Bittern	1	0	0	0	1	1	1	1	1	0	-	6
Great Blue Heron	0	0	2	0	0	0	0	0	0	0	-	2
Green Heron	0	0	0	0	0	0	0	0	1	0	-	1
Northern Goshawk	0	0	0	0	1	0	0	0	0	0	-	1
American Kestrel	0	0	0	0	0	0	0	1	1	0	-	2
Killdeer	4	2	3	1	3	0	0	0	1	1	-	15
Spotted Sandpiper	1	1	1	1	3	0	1	1	0	2	-	11
Wilson's Snipe	6	1	4	5	2	0	3	5	3	2	-	31
Rock Pigeon	6	4	0	0	1	2	0	1	0	2	-	16
Mourning Dove	20	18	10	16	23	13	12	8	11	8	-	139
Black-billed Cuckoo	0	0	0	0	0	2	0	0	0	0	-	2
Chimney Swift	3	1	0	1	2	0	0	0	0	0	-	7
Ruby-throated Hummingbird	1	1	1	1	0	4	2	0	2	1	-	13
Belted Kingfisher	0	0	0	1	0	0	0	0	0	0	-	1
Yellow-bellied Sapsucker	0	3	1	0	2	3	2	5	1	1	-	18
Downy Woodpecker	0	1	1	0	2	0	0	0	0	0	-	4
Hairy Woodpecker	0	0	0	0	0	0	0	1	0	1	-	2
Northern Flicker	2	2	2	1	3	0	1	0	3	2	-	16
Pileated Woodpecker	1	2	1	0	1	0	0	0	0	0	-	5
Olive-sided Flycatcher	0	2	0	0	1	1	0	0	0	0	-	4
Eastern Wood-Pewee	1	0	0	1	1	0	1	0	2	0	-	6
Alder Flycatcher	15	5	12	12	10	8	18	16	7	9	-	112
Willow Flycatcher	0	0	1	1	0	0	2	0	1	0	-	5
Least Flycatcher	5	1	3	0	1	0	2	0	3	1	-	16
Eastern Phoebe	10	3	7	9	4	4	2	8	1	11	-	59
Great Crested Flycatcher	0	1	0	0	1	0	1	0	0	0	-	3
Eastern Kingbird	1	0	1	1	0	2	0	1	1	1	-	8
Blue-headed Vireo	3	7	3	6	3	1	3	2	6	6	-	40
Warbling Vireo	1	4	4	2	4	3	5	1	0	2	-	26
Red-eyed Vireo	18	27	25	20	26	29	13	20	32	32	-	242
Blue Jay	2	14	17	11	12	5	22	2	11	7	-	103
American Crow	47	40	29	25	42	37	33	39	37	57	-	386
Common Raven	1	2	0	1	8	0	2	1	0	1	-	16
Tree Swallow	12	18	11	5	3	3	6	12	3	17	-	90
Bank Swallow	7	5	3	6	2	2	1	0	0	0	-	26
Cliff Swallow	3	0	0	0	0	0	0	0	0	0	-	3
Barn Swallow	22	21	8	4	4	6	4	2	2	0	-	73
Black-capped Chickadee	5	24	11	37	23	9	24	18	12	19	-	182
Tufted Titmouse	0	0	0	0	0	0	1	0	0	0	-	1
Red-breasted Nuthatch	3	4	4	2	6	1	4	0	4	0	-	28
White-breasted Nuthatch	2	0	0	1	4	0	4	1	0	0	-	12
House Wren	1	0	0	2	1	0	1	0	0	0	-	5
Winter Wren	10	8	4	4	5	2	1	10	9	6	-	59
Eastern Bluebird	3	0	0	0	0	0	2	1	0	0	-	6
Veery	8	7	7	2	6	5	2	2	8	1	-	48
Swainson's Thrush	1	0	1	0	0	0	0	1	0	0	-	3
Hermit Thrush	4	8	10	4	2	2	6	0	11	4	-	51
Wood Thrush	5	10	5	7	6	6	3	3	1	3	-	49
American Robin	62	56	43	54	53	45	54	57	45	29	-	498
Gray Catbird	2	3	1	3	2	1	0	1	2	1	-	16
Brown Thrasher	0	0	0	0	1	1	4	0	0	0	-	6
European Starling	51	43	49	84	88	39	41	37	14	57	-	503
Cedar Waxwing	3	11	5	7	10	14	5	10	3	7	-	75
Nashville Warbler	1	2	1	1	0	1	0	1	1	2	-	10
Northern Parula	1	1	0	1	0	0	2	0	2	4	-	11
Yellow Warbler	3	5	3	7	0	2	6	4	0	0	-	30
Chestnut-sided Warbler	18	7	10	9	8	9	10	7	8	15	-	101
Magnolia Warbler	3	3	0	1	4	2	2	3	0	1	-	19
Black-throated Blue Warbler	1	0	4	0	0	1	2	1	1	1	-	11
Yellow-rumped Warbler	5	3	13	10	8	1	3	2	5	3	-	53
Black-throated Green Warbler	6	1	5	1	2	0	6	3	1	3	-	28
Blackburnian Warbler	1	0	2	1	1	1	3	2	3	0	-	14
Pine Warbler	0	0	0	0	0	0	0	0	0	2	-	2
Blackpoll Warbler	0	0	0	0	0	1	0	0	0	0	-	1
Black-and-white Warbler	6	3	2	3	6	1	6	0	3	0	-	30
American Redstart	12	10	2	3	3	0	3	2	2	3	-	40
Ovenbird	23	10	12	19	14	8	23	13	14	5	-	141
Northern Waterthrush	1	0	0	0	0	0	0	0	0	2	-	3
Mourning Warbler	0	0	0	0	1	0	0	0	0	0	-	1
Common Yellowthroat	29	34	28	24	27	19	31	23	27	18	-	260
Canada Warbler	1	0	0	1	0	0	0	0	0	0	-	2
Scarlet Tanager	3	3	2	1	2	2	3	0	5	0	-	21
Chipping Sparrow	10	3	7	5	8	7	11	3	9	4	-	67
Vesper Sparrow	0	2	0	0	0	0	0	0	0	0	-	2
Savannah Sparrow	6	13	10	6	17	11	8	6	13	16	-	106
Song Sparrow	25	22	37	24	27	27	29	31	37	38	-	297
Swamp Sparrow	1	1	0	2	0	0	0	0	0	1	-	5
White-throated Sparrow	23	18	19	10	20	6	27	13	23	11	-	170
Dark-eyed Junco	1	0	1	1	1	1	2	1	1	0	-	9
Rose-breasted Grosbeak	0	6	1	1	1	0	2	2	2	1	-	16
Indigo Bunting	0	2	2	2	0	2	1	3	8	3	-	23
Bobolink	55	30	30	28	16	16	12	18	15	11	-	231
Red-winged Blackbird	50	61	79	58	44	49	56	59	62	69	-	587
Eastern Meadowlark	5	1	0	1	0	1	0	1	0	1	-	10
Common Grackle	13	44	38	25	17	18	22	8	16	22	-	223
Brown-headed Cowbird	6	3	1	0	3	3	7	1	11	4	-	39
Baltimore Oriole	0	2	2	0	0	2	0	0	0	0	-	6
Purple Finch	0	1	0	0	0	0	0	0	1	6	-	8
House Finch	0	0	1	0	1	0	0	0	0	0	-	2
Pine Siskin	25	0	0	0	0	0	23	0	0	0	-	48
American Goldfinch	8	3	8	6	11	12	10	8	8	11	-	85
Evening Grosbeak	0	2	2	0	0	0	0	0	0	0	-	4
House Sparrow	1	5	3	1	0	1	1	0	1	4	-	17
Total Species	71	66	63	64	64	56	65	58	58	58	0	avg: 62.3
Total Individuals	698	662	622	593	616	456	603	503	519	554	0	avg: 582.6

Appendix A Table 3. Christmas Bird Count Data from the Craftsbury-Greensboro, Vermont count; 1991 through 2001

Common Name	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Total
Canada Goose	0	0	0	0	0	0	0	0	0	1	100	101
American Black Duck	0	0	0	0	0	0	0	0	0	18	0	18
Mallard	0	0	0	0	0	0	0	0	0	3	0	3
Northern Pintail	0	0	0	0	0	0	0	0	0	1	0	1
Common Goldeneye	0	0	0	0	0	0	0	0	18	17	0	35
Barrow's Goldeneye	0	0	0	0	0	0	0	0	0	2	0	2
Hooded Merganser	0	0	0	0	0	0	0	0	0	45	0	45
Common Merganser	0	0	0	0	0	0	0	0	9	26	0	35
Ruffed Grouse	7	3	10	4	0	8	5	0	12	6	1	56
Wild Turkey	0	0	0	0	0	0	11	3	47	19	20	100
Great Blue Heron	0	0	0	0	0	0	1	0	0	0	0	1
Northern Harrier	0	0	0	0	0	0	0	0	0	0	1	1
Sharp-shinned Hawk	0	2	0	0	0	0	0	1	0	0	0	3
Cooper's Hawk	0	0	0	0	1	3	0	0	0	0	0	4
Northern Goshawk	1	0	4	2	0	1	1	0	0	0	1	10
Red-tailed Hawk	0	0	0	0	0	0	1	1	0	2	1	5
Rough-legged Hawk	2	0	0	0	1	0	0	0	2	1	1	7
Ring-billed Gull	0	0	0	1	0	0	2	0	0	0	0	3
Herring Gull	0	0	0	0	0	0	0	0	12	31	0	43
Rock Dove	310	241	210	181	264	247	277	154	202	116	29	2231
Mourning Dove	5	69	40	58	45	113	45	34	95	0	28	532
Northern Hawk Owl	0	1	0	0	0	0	0	0	0	0	0	1
Barred Owl	0	0	0	1	0	0	0	1	0	0	0	2
Downy Woodpecker	19	24	17	7	12	14	13	5	12	22	7	152
Hairy Woodpecker	24	27	17	16	15	22	13	13	7	17	4	175
Black-backed Woodpecker	0	1	0	1	0	0	0	0	0	0	0	2
Pileated Woodpecker	2	4	4	6	4	0	3	3	2	5	1	34
Northern Shrike	0	5	0	2	2	2	7	1	6	10	1	36
Gray Jay	0	0	1	0	0	0	0	0	0	0	0	1
Blue Jay	172	307	209	91	262	136	266	108	63	169	53	1836
American Crow	162	105	52	37	80	127	155	58	142	79	57	1054
Common Raven	17	40	17	27	87	22	11	29	24	42	4	320
Black-capped Chickadee	992	1489	1085	462	583	679	584	287	635	772	148	7716
Boreal Chickadee	1	12	7	3	4	0	0	0	2	6	0	35
Tufted Titmouse	1	0	0	0	0	5	0	0	0	1	0	7
Red-breasted Nuthatch	36	232	52	12	72	34	33	3	45	44	26	589
White-breasted Nuthatch	18	26	17	7	3	8	9	5	9	31	2	135
Brown Creeper	2	9	0	2	2	0	3	2	3	2	1	26
Winter Wren	0	0	1	0	0	0	1	0	0	0	0	2
Golden-crowned Kinglet	21	59	10	3	45	2	11	2	26	9	4	192
American Robin	0	0	1	0	5	0	0	0	2	0	1	9
Northern Mockingbird	0	0	1	0	0	0	0	0	0	0	0	1
European Starling	471	617	155	349	590	120	738	664	735	156	142	4737
Bohemian Waxwing	0	38	4	0	0	0	0	0	0	9	0	51
Cedar Waxwing	0	0	0	0	2	0	0	1	0	0	0	3
American Tree Sparrow	20	31	9	17	111	14	24	10	46	7	19	308
White-throated Sparrow	0	0	0	0	6	0	1	0	0	0	0	7
Dark-eyed Junco	0	1	2	1	141	0	19		10	1	6	181
Snow Bunting	209	21	90	0	0	22	8	0	30	0	5	385
Northern Cardinal	16	9	3	2	3	9	5	2	2	3	0	54
Red-winged Blackbird	0	1	0	0	0	0	0	0	0	0	1	2
Common Grackle	0	3	0	1	0	3	0	0	0	0	0	7
Brown-headed Cowbird	2	12	2	18	112	3	20	4	0	0	20	193
Pine Grosbeak	0	0	0	16	0	65	0	131	0	86	0	298
Purple Finch	0	646	39	0	325	4	5	0	31	13	20	1083
House Finch	12	20	15	4	18	0	20	0	16	0	0	105
Carpodacus sp.	0	0	0	0	0	25	0	0	0	0	0	25
Red Crossbill	0	0	0	0	0	0	0	0	1	0	0	1
White-winged Crossbill	0	0	0	0	106	0	2	0	4	0	12	124
Common Redpoll	0	18	0	227	0	92	0	114	0	145	0	596
Pine Siskin	0	866	27	0	1034	18	69	0	0	15	8	2037
American Goldfinch	2	215	435	2	285	5	319	0	133	20	55	1471
Evening Grosbeak	158	753	250	62	247	241	54	50	0	32	10	1857
House Sparrow	80	113	191	187	115	105	195	83	196	66	34	1365
Total Species	64	64	64	64	64	64	64	63	64	64	64	avg: 32.73
Total Individuals	2826	6084	3041	1873	4646	2213	2995	1832	2643	2114	887	avg: 2801

Appendix A Table 4. Available raptor mortality data reported at wind farms in the U.S. (outside of California) from 1994-2009

Location	Habitat Type (# Turbines)	Study period	Search Interval	Number of fatalities and species	Dates of carcass discovery	Reference
Buffalo Ridge, MN	agricultural grassland (73)	1994-1995	30-50 weekly	0	n/a	Osborn *et al.* 2000
Buffalo Ridge, MN	agricultural grassland (138)	1996-1999	30 per 14 days	1 red-tailed hawk	n/a	Johnson *et al*. 2002
Searsburg, VT	forested ridge (11)	1997	11 total (4 per search) 2-6 days per month	0	n/a	Kerlinger 2002
Foote Creek Rim, WY	shrub-steppe grassland (69)	1998-2002	35 searched once every 2 weeks	1 northern harrier, 3 American kestrel, 1 short-eared owl	Northern harrier (4/19/99); American kestrel (5/12/99, 10/12/99, 7/19/00); short-eared owl (09/28/00)	Young *et al.* 2003
Vansycle, Umatilla County, Oregon	agricultural grassland (38)	1999	All turbines searched each 28-day period	0	n/a	Erickson *et al.* 2000
Stateline, WA/OR	agricultural grassland (454)	2001-2003	120-150 total	9 red-tailed hawk, 3 American kestrel, 1 ferruginous hawk, 1 Sawinson's hawk, 1 short-eared owl	Total raptor fatalities 2002: 1 in June, 2 in August, 2 in September, and 1 in October; 2003: 1 in May, 1 in June, 3 in July, 2 in October	Erickson *et al.* 2004
Somerset County, PA	agricultural grassland (8)	2000	n/a	0	n/a	Kerlinger 2006
Nine Canyon, WA	shrub-steppe grassland (37)	2002-2003	1 x 2 weeks	1 American kestrel, 1 short-eared owl	American kestrel (11/18/02), short-eared owl (4/7/03)	Erickson *et al.* 2003
Klondike, OR	shrub-steppe grassland (16)	2002-2003	1 x month	0	n/a	Johnson et al. 2003
Mountaineer, WV	forested ridge (44)	2003	2 x per week	1 red-tailed hawk, 2 turkey vultures	each between 04/04/03 - 04/27/03, 06/02/03 -06/24/03, 07/28/03 - 07/29/03, and 08/18/03 - 11/22/03	Kerns and Kerlinger 2004
Mountaineer, WV	forested ridge (44)	2004	22 daily, 22 weekly	1 sharp-shinned hawk, 1 turkey vulture	both between 07/31/04 - 09/11/04	Arnett *et al* 2005
Meyersdale, PA	forested ridgeline (20)	2004	10 daily, 10 weekly	0	n/a	Arnett *et al.* 2005
Top of Iowa, Iowa	agricultural grassland (89)	2004	26 every 3 days	1 red-tailed hawk	red-tailed hawk (4/01/04 - 12/10/04)	Koford *et al*. 2005
Buffalo Mountain, TN	open/shrubland (18)	2005	18 of 18 every week, every 2 weeks, or every 2-5 days	0	n/a	Fiedler *et al*. 2007
Kewaunee County, Wisconsin	agricultural grassland (31)	1999-2001	n/a	0	n/a	Howe *et al.* 2002
Maple Ridge, NY	woodland, agricultural grassland (120)	2006	10 every 3 days, 30 7 days, 10 daily	1 American kestrel	American kestrel (7/06)	Jain *et al*. 2007
Maple Ridge, NY	woodland, agricultural grassland (195)	2007	64 weekly	1 American kestrel, 5 red-tailed hawk	red-tailed hawk (1 found 8/07, 2 found 9/07) // (1 sharp-shinned hawk and 2 red-tailed hawk dates not reported)	Jain et al. 2008
Maple Ridge, NY	woodland, grassland, agricultural (120)	2008	64 weekly	1 American kestrel, 2 sharp-shinned hawk, 1 Cooper's hawk	n/a	Jain *et al.* 2009a
Mars Hill, ME	forested ridgeline (28)	2007	2 of 28 daily, 28 of 28 weekly, seasonal dog searches	0	n/a	Stantec 2008a
Mars Hill, ME	forested ridgeline (28)	2008	28 of 28 weekly, seasonal dog searches	1 barred owl	barred owl (4/11/08)	Stantec 2009b
Mt. Storm, WV	forested ridgeline (82)	2008	18 weekly, 9 daily	2 turkey vulture	9/25/2008 and 10/13/2008	Young *et al*. 2009
Lempster, NH	forested ridgeline (12)	2009*	4 daily	0	n/a	Tidhar 2009
Clinton, NY	agricultural, woodland (67)	2008	8 daily, 8 every 3-days, 7 every 7-days	1 broad-winged hawk	May	Jain et al. 2009b
Ellenburg, NY	agricultural, woodland (54)	2008	6 daily, 6 every 3-days, 6 every 7-days	1 broad-winged hawk	June	Jain et al. 2009c
Bliss, NY	agricultural, woodland (67)	2008	8 daily, 8 every 3-days, 7 every 7-days	3 red-tailed hawk, 1 sharp-shinned hawk	1 fatality in June, 1 fatality in August (2 incidental raptor dates not reported)	Jain et al. 2009d

*Results of spring interim report, study period April 20 to June 1.

Appendix A Table 5. Summary of available spring raptor data at proposed wind sites in the East 1999-2008

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Seasonal Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
Spring 1999									
Wethersfield, Wyoming Cty, NY	Agricultural plateau	April 20 - May 24	24	97	348	12	3.6	n/a (23 m mean flight height)	Cooper, B.A., and T.J. Mabee. 1999. Bird migration near proposed wind turbine sites at Wethersfield and Harrisburg, New York. Unpublished report prepared for Niagara–Mohawk Power Corporation, Syracuse, NY, by ABR, Inc., Forest Grove, OR. 46 pp.
Spring 2003									
Westfield, Chautauqua Cty, NY	Great Lakes Shore	April 16 - May 15	50	100.7	2,578	17	25.6	n/a (278 m mean flight height)	Cooper, B.A., A.A. Stickney, J.J. Mabee. 2004. A visual and radar study of 2003 spring bird migration at the proposed Chautauqua wind energy facility, New York. 2004. Final Report prepared by ABR Inc. Chautauqua Windpower LLC.
Spring 2005									
Churubusco, Clinton Cty, NY	Great Lakes plain/ADK foothills	Spring 2005	10	60	170	11	2.83	(120 m) 69%	Woodlot Alternatives, Inc. 2005. A Spring Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
Clinton/Ellenburg, Clinton Cty, NY	Great Lakes plain/ADK foothills	April 18 to April 20	3	21	(2 non-migrant BWHA)	1	0.1***	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Dairy Hills, Clinton Cty, NY	Great Lakes Shore	April 15 to April 26	5	20	50	6	2.5	(125 m) 94.7%*	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Altona, Clinton Cty, NY	Great Lakes plain/ADK foothills	May 5 to May 6	3	21	(4 non-migrant TUVU)	1	0.19***	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Bliss Wind Park, Eagle, Wyoming Cty, NY	Agricultural and wooded plateau	April 21, 26, 28	3	21	19	3	0.9	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Alabama, Genesee Cty, NY	Great Lakes plain/ADK foothills	April 16-April 29	5	20	177	8	9	(125 m) 84.5%*	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
High Sheldon, Wyoming Cty, NY	Agricultural and wooded plateau	April 2 to May 14	7	37	119	7	3.2	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Wethersfield, Wyoming Cty, NY	Agricultural and wooded plateau	April 22 to April 29	3	21	5	3	0.1	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
New Grange, Chautauqua Cty, NY	Great Lakes plain/ADK foothills	April 16 to May	5	20	55	8	4.37	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Stockton, Chautauqua Cty, NY	Great Lakes plain/ADK foothills	April 16 to May 15	5	20	122	8	4.65	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Clayton, Jefferson Cty, NY	Agricultural plateau	March 30 - May 7	10	58	700	14	12.1	(150 m) 61%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
Prattsburgh, Steuben Cty, NY	Agricultural plateau	Spring 2005	10	60	314	15	5.23	(125 m) 83%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
Cohocton, Steuben Cty, NY	Agricultural plateau	Spring 2005	10	60	164	11	2.73	(125 m) 77%	Woodlot Alternatives, Inc. 2005. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC.
Munnsville, Madison Cty, NY	Agricultural plateau	April 5 to May 16	10	60	375	12	6.25	(118 m) 78%	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
Moresville, Delaware County, NY	Forested ridge	March 28 to May 10	8	45	170	6	3.8	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Sheffield, Caledonia Cty, VT	Forested ridge	April to May	10	60	98	10	1.63	(125 m) 69%	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Deerfield, Bennington Cty, VT (Existing facility)	Forested ridge	April 9 to April 29	7	42	44	11 (for both sites combined)	1.05	(125 m) 83% (at both sites combined)	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy/Deerfield Wind, LLC.
Deerfield, Bennington Cty, VT (Western expansion)	Forested ridge	April 9 to April 29	7	42	38	11 (for both sites combined)	0.9	(125 m) 83% (at both sites combined)	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy/Deerfield Wind, LLC.

Appendix A Table 5 Continued. Summary of available spring raptor data at proposed wind sites in the East 1999-2008

Spring 2006									
Mars Hill, Aroostook Cty, ME	Forested ridge	April 12 to May 18	10	60.25	64	9	1.06	(120 m) 48%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Radar, Visual, and Acoustic Survey of Bird Migration at the Mars Hill Wind Farm in Mars Hill, Maine. Prepared for Evergreen Windpower, LLC.
Lempster, Sullivan County, NH	Forested ridge	Spring 2006	10	78	102	n/a	1.3	(125 m) 18%	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Nocturnal Bird Migration,Breeding Birds, and Bicknell's Thrush at the Proposed Lempster Mountain Wind Power Project Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
Howard, Steuben Cty, NY	Agricultural plateau	April 3 to May 19	9	52.5	260	11	4.95	(125 m) 64%	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
Chateaugay, Franklin Cty, NY	Great Lakes plain/ADK foothills	April 19 to April 28	3	21	47	12	1.9	(121 m) 3%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
St. Lawrence, Jefferson Cty, NY	Great Lakes Shore	April 14 to May 12	4	12	91	8	7.5	(125 m) 81%**	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Cape Vincent, Jefferson Cty, NY	Great Lakes Shore	April 14 to May 12	4	12	79	10	6.5	(125 m) 72%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Stockton, Chautauqua Cty, NY	Great Lakes plain/ADK foothills	n/a	n/a	n/a	n/a	n/a	4.65	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Spring 2007									
St Lawrence, Jefferson Cty, NY	Great Lakes Shore	March 21 to May 1	7	21	232	8	15.4	(125 m) 81%**	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Cape Vincent, Jefferson Cty, NY	Great Lakes Shore	March 21 to May 1	7	21	205	9	9.8	(125 m) 72%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
New Grange, Chautauqua Cty, NY	Great Lakes plain/ADK foothills	April 26 to May 22	5	n/a	n/a	n/a	4.37	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Jericho Rise, Franklin Cty, NY	Great Lakes plain/ADK foothills	April 4 to May 28	8	32	112	10	3	(125 m) 74.6%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Stetson, Penobscot Cty, ME	Forested ridge	April 26 to May 4	9	59	34	10	0.6	(125 m) 65%	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Laurel Mountain, Preston Cty, WV	Forested ridge	March 30 to May 17	10	63.75	266	12	4.17	(125 m) 55%	Stantec Consulting. 2008. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia – November 2007. Prepared for AES Laurel Mountain, LLC.
Spring 2008									
Oakfield, Aroostook Cty, ME	Agricultural plateau	April 25- May 30	12	79	58	9	0.7	(120 m) 80%	Stantec Consulting. 2008. Spring and Summer 2008 Bird and Bat Migration Survey Report Visual, Radar, and Acoustic Bat Surveys for the Oakfield Wind Project in Oakfield, Maine. Prepared for First Wind Management, LLC.
Roxbury, Oxford Cty, ME	Forested ridge	March 11 to May 27	15	97	118	12	1.2	n/a	Stantec Consulting. 2008. Spring 2008 Bird and Bat Migration Survey Report Breeding Bird, Raptor, and Acoustic Bat Surveys for the Record Hill Wind Project Roxbury, Maine. Prepared for Record Hill Wind, LLC.
Lincoln, Penobscot Cty, ME	Forested ridge	April 3 to June 3	15	108	122	12	1.1	(125 m) 76%	Stantec Consulting. 2008. Spring 2008 Bird and Bat Migration Survey Report Visual, Radar, and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for First Wind Management, LLC.
Greenland, Grant Cty, WV	Forested ridge	March 21 to May 14	10	68	212	9	3.12	(125 m) 68%	Stantec Consulting. 2008. Spring, Summer, and Fall 2008 Bird and Bat Migration Survey Report Visual, Radar, and Acoustic Bat Surveys for the New Creek Mountain Project West Virginia. Prepared for AES New Creek, LLC.

*Calculated for spring and fall combined.

**Calculated for spring and fall 2006 and 2007 combined.

***Non-migrants were not included in seasonal passage rates in NYSDEC 2008 table but were included in passage rates here.

Appendix A Table 6. Summary of available fall raptor survey results at wind sites in the east

Project Site	Landscape	Survey Period	# of Survey Days	# of Survey Hours	Total # Observed	# of Species Observed	Ave. Passage Rate (Raptors/Hr)	(Turbine Ht) % Raptors Below Turbine Height	Seasonal Passage Rate (raptors/hr)	(Turbine Ht) and % Raptors Below Turbine Height	Reference
Fall 1996											
Searsburg, Bennington County, VT	Forested ridge	Sept. 11 - Nov. 3	20	80	430	12	5.38	n/a	5.4	n/a	Kerlinger, Paul. 1996. A Study of Hawk Migration at Green Mountain Power Corporation's Searsburg, Vermont, Wind Powewer Site: Autumn 1996. Prepared for the Vermont Public Service Board, Green Mountain Power, National Renewable Energy Laboratory, VERA.
Fall 1998											
Harrisburg, Lewis County, NY	Great Lakes plain/ADK foothills	Sept. 2 - Oct. 1	13	68	554	12	8.1	n/a (48 m mean flight height)	8.1	n/a (48 m mean flight height)	Cooper, B.A., and T.J. Mabee. 1999. Bird migration near proposed wind turbine sites at Wethersfield and Harrisburg, New York. Unpublished report prepared for Niagara–Mohawk Power Corporation, Syracuse, NY, by ABR, Inc., Forest Grove, OR. 46 pp.
Wethersfield, Wyoming Cty, NY	Agricultural plateau	Sept. 2 - Oct. 1	24	107	256	12	2.4	n/a (47 m mean flight height)	2.4	n/a (47 m mean flight height)	Cooper, B.A., and T.J. Mabee. 1999. Bird migration near proposed wind turbine sites at Wethersfield and Harrisburg, New York. Unpublished report prepared for Niagara–Mohawk Power Corporation, Syracuse, NY, by ABR, Inc., Forest Grove, OR. 46 pp.
Fall 2004											
Prattsburgh, Steuben Cty, NY	Agricultural plateau	Sept. 2 - Oct. 28	13	73	220	10	3.01	(125 m) 62%	3.0	(125 m) 62%	Woodlot Alternatives, Inc. 2005. A Fall 2004 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind Management, LLC.
Cohocton, Stueben, Cty, NY	Agricultural plateau	Sept. 2 - Oct. 28	8	41.3	128	8	3.1	(125 m) 80%	3.1	(125 m) 80%	Woodlot Alternatives, Inc. 2005. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC.
Deerfield, Bennington Cty, VT (Existing Facility)	Forested ridge	Sept. 2 - Oct. 31	10	60	147	11 for both sites combined	2.45	(100 m) 9% for both sites combined	2.5	(100 m) 9% for sites combined	Woodlot Alternatives, Inc. 2005. Fall 2004 Avian Migration Surveys at the Proposed Deerfield Wind/Searsburg Expansion Project in Searsburg and Readsboro, Vermont. Prepared for Deerfield Wind, LLC and Vermont Environmental Research Associates.
Deerfield, Bennington Cty, VT (Western Expansion)	Forested ridge	Sept. 2 - Oct. 31	10	57	725	11 for both sites combined	12.72	(100 m) 9% for both sites combined	12.7	(100 m) 9% for sites combined	Woodlot Alternatives, Inc. 2005. Fall 2004 Avian Migration Surveys at the Proposed Deerfield Wind/Searsburg Expansion Project in Searsburg and Readsboro, Vermont. Prepared for Deerfield Wind, LLC and Vermont Environmental Research Associates.
Sheffield, Caledonia Cty, VT	Forested ridge	Sept. 11 - Oct. 14	10	60	193	10	3.2	(125 m) 31%	3.2	(125 m) 31%	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
Fall 2005											
Alabama, Genesee Cty, NY	Great Lakes plain/ADK foothills	Sept. 11 - Oct. 10	5	19	148	4	8	(125 m) 84.5%	8.0	85%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
High Sheldon, Wyoming Cty, NY	Agricultural and wooded plateau	Aug. 29 - Nov. 4	8	53.5	168	9	3.1	n/a	3.1	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Wethersfield, Wyoming Cty, NY	Agricultural plateau	Sept. 13 - Sept. 18	3	21	0	0	0	n/a	0	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Bliss, Wyoming Cty, NY	Agricultural and wooded plateau	Sept. 12 - Sept. 17	2	21	0	0	0	n/a	0	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Cohocton, Stueben, Cty, NY	Agricultural plateau	Sept. 7 - Oct. 1	7	40.12	131	10	3.27	(125 m) 63%	3.3	(125) 63%	Woodlot Alternatives, Inc. 2005. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC.
West Hill, Madison Cty, NY	Agricultural plateau	Sept. 6 - Oct. 31	11	65	369	14	5.68	(118 m) 51%	5.7	(118 m) 51%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed
Clinton / Ellenburg, Clinton Cty, NY	Agricultural plateau	Sept. 23 - Sept. 28	3	21	0	0	0	n/a	0	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Altona, Clinton Cty, NY	Great Lakes plain/ADK foothills	Sept. 24 - Sept. 30	3	21	0	0	0	n/a	0	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Marble River, Clinton Cty, NY	Great Lakes plain/ADK foothills	Sept. 6 - Nov. 2	10	60	217	15	3.62	(120 m) 69%	3.6	69%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
New Grange, Chautauqua Cty, NY	Forested ridge	Sept. 17 - Oct. 15*	6	18	49	5	4.37	n/a	4.4	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Moresville, Deleware Cty, NY	Forested ridge	Aug. 31 - Nov. 3	11	72	228	11	3.2	n/a	3.2	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Churubusco, Clinton Cty, NY	Great Lakes plain/ADK foothills	Sept. 6 - Oct. 22	10	60	217	15	3.62	(120 m) 69%	3.6	(120 m) 69%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
Dairy Hills, Wyoming Cty, NY	Agricultural plateau	Sept. 11 - Oct. 10	4	16	48	6	3	(125 m) 94.7%	3.0	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed November 7, 2008.
Howard, Steuben Cty, NY	Agricultural plateau	Sept. 1 - Oct. 28	10	57	206	12	3.6	(91 m) 65%	3.6	(91 m) 65%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
Munnsville, Madison Cty, NY	Agricultural plateau	Sept. 6 - Oct. 31	11	65	369	14	5.68	(118 m) 51%	5.7	(118 m) 51%	Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
Mars Hill, Aroostook Cty, ME	Forested ridge	Sept. 9 - Oct. 13	8	42.5	115	13	1.52	(120 m) 42%	1.5	(120 m) 42%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC.
Lempster, Sullivan County, NH	Forested ridge	Fall 2005	10	80	264	10	3.3	(125 m) 40%	3.3	(125 m) 40%	Woodlot Alternatives, Inc. 2007. Lempster Wind Farm Wildlife Habitat Summary and Assessment. Prepared for Lempster Wind, LLC.
Clayton, Jefferson Cty, NY	Agricultural plateau	Sept. 9 - Oct. 16	11	63.5	575	13	9.1	(150 m) 89%	9.1	(150 m) 89%	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.

Appendix A Table 6 Continued. Summary of available fall raptor survey results at wind sites in the east

Fall 2006										
Stetson, Penobscot Cty, ME	Forested ridge	Sept. 14 - Oct. 26	7	42	86	11	2.05	(125 m) 63%	2.1	(125 m) 63%	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
Lincoln, Penobscot Cty, ME	Forested ridge	Sept. 13 - Oct. 16	12	89	144	12	1.8	(120 m) 82%	1.8	(120 m) 82%	Woodlot Alternatives, Inc. 2007. Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V.
Wethersfield, Wyoming Cty, NY	Agricultural plateau	Sept. 21 - Nov. 11	3	21?	231	11	9.7	(122 m) 27%	9.7	27%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed
Chateaugay, Franklin Cty, NY	Great Lakes plain/ADK foothills	Sept. 6 - Oct. 26	2	24	42	5	1.6	(122 m) 31%	1.6	31%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed
St. Lawrence, Jefferson Cty, NY	Agricultural plateau	Sept. 23 - Nov. 11	10	30	288	10	9.6	(125 m) 81%	9.6	81%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed
Cape Vincent, Jefferson Cty, NY	Great Lakes plain/ADK foothills	Sept. 23 - Nov. 11	10	30	165	10	5.5	(125 m) 72%	5.5	72%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed
Jordanville, Herkimer Cty, NY	Agricultural plateau	Oct. 13 - Nov. 30	44	234.7	629	12	2.7	(125 m) 67%	2.7	67%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed
Fall 2007										
Roxbury, Oxford Cty, ME	Forested ridge	Sept. 3 - Oct. 15	14	86	96	12	1.1	n/a	1.1	n/a	Stantec Consulting. 2008. Fall 2007 Migration Survey Report Visual, Acoustic, and Radar Surveys of Bird and Bat Migration conducted at the proposed Record Hill Wind Project
Errol, Coos Cty, NH	Forested ridge	Sept. 5 - Oct. 16	11	68	44	9	0.7	n/a	0.7	n/a	Stantec Consulting. 2007. Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC. Prepared for Granite Reliable Power, LLC.
Laurel Mountain, Preston Cty, WV	Forested ridge	Sept. 12 - Dec. 1	24	147	769	12	5.2	(125 m) 65%	5.2	(125 m) 65%	Stantec Consulting Services Inc. 2007. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Laurel Mountain Wind Energy Project near Elkins, West Virginia. Prepared for AES Laurel Mountain, LLC.
Greenland, Grant Cty, WV	Forested ridge	Sept. 12 - Dec. 1	27		858	13	5.9	(125 m) 67%	5.9	(125 m) 67%	Stantec Consulting Services Inc. 2008. A Fall 2007 Survey of Bird and Bat Migration at the New Creek Wind Project,West Virginia. Prepared for AES New Creek, LLC.
New Grange, Chautauqua Cty, NY	Forested ridge	Sept. 21 - Oct. 28	6	n/a	n/a	n/a	4.37	n/a	4.4	n/a	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed
Allegany, Cattaraugus Cty, NY	Forested ridge	Sept. 8 - Oct. 11	11	63.78	125	10	1.96	(150 m) 78%	2.0	78%	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed
Jericho Rise, Franklin Cty, NY	Great Lakes plain/ADK foothills	Sept. 12 - Oct. 26	7	28	59	7	2	(125 m) 74.6%	2.0	74.6% (for spring and fall combined)	New York State Department of Environmental Conservation. 2008. Publicly Available Raptor Migration Data for Proposed Wind Sites in NYS. Available at http://www.dec.ny.gov/docs/wildlife_pdf/raptorwinsum. Accessed
Fall 2008										
Oakfield, Aroostook Cty, ME	Agricultural plateau	Sept. 26 - Oct. 14	12	84	60	8	0.7	(120 m) 67%	0.7	(120 m) 67%	Woodlot Alternatives, Inc. 2008. A Fall 2008 Survey of Bird and Bat Migration at the Oakfield Wind Project, Washington County, Maine. Prepared for Evergreen Wind, LLC.

*Calculated for spring and fall combined.

**Calculated for spring and fall 2006 and 2007 combined.

***Non-migrants were not included in seasonal passage rates in NYSDEC 2008 table but were included in passage rates here.

Appendix A Table 7. Comparison of bird mortality at existing wind farms in the east and upper mid-west, U.S.						
Site	**Habitat type (# turbines)**	**Dates surveyed**	**Search interval**	**# BIRDS found during surveys (incidental)**	**Estimated total BIRD fatalities/turbine/year (total)**	**Reference**
Buffalo Ridge, Minnesota	agricultural grassland (73)	April 1994 - Dec 1995	30-50 weekly	7	0.33-0.66 fatalities/t/yr (36 total)	Osborn *et al*. 2000
Buffalo Ridge, Minnesota (Phase 3)	agricultural grassland (138)	15 March - 15 November, 1999	30 every 14 days	20	4.45/t/yr (613)	Johnson *et al.* 2002
Buffalo Ridge, Minnesota	agricultural grassland (281)	15 June - 15 September, 2001 and 2002	83 of 103 bi-weekly	n/a	n/a	Johnson and Strickland 2004
Searsburg, Vermont	forested (11)	30 June - 18 October, 1997	11 total (4 per search) 2 to 6 days per month	0	n/a	Kerlinger 2002
Kewaunee County, Wisconsin	agricultural (31)	1999 - 2001	n/a	25	1.29/t/yr (40)	Sagrillo 2003, Sagrillo 2007
Somerset County, Pennsylvania	agricultural (8)	2000 (12 months)	n/a	0	n/a	Kerlinger 2006
Mountaineer, West Virginia	forested ridgeline (44)	4 April - 11 Nov, 2003	2x per week	69*	4.04/t/yr (178 + 33 due to substation lighting)	Kerns and Kerlinger, 2004
Mountaineer, West Virginia	forested ridgeline (44)	31 July- 11 September, 2004	22 daily, 22 weekly	15 (n/a)	n/a	Arnett 2005
Meyersdale, Pennsylvania	forested ridgeline (20)	2 August - 13 September, 2004	10 daily, 10 weekly	13 (4)	n/a	Arnett 2005
Top of Iowa, Iowa	agricultural (89)	24 March- 10 December, 2004	26 every 3-days	5 (n/a)	0.9/t/yr (80 total)	Koford et al. 2005
Buffalo Mtn, Tennessee	reclaimed mine on ridge (18)	April - December, 2005	18 of 18 every week, every 2 weeks, or every 2-5 days	9 (2)	1.8/t/yr (111.6 total)	Fiedler *et al.* 2007
Maple Ridge, New York	woodland, grassland, agricultural (120)	June 17 - November 15, 2006	10 every 3-days, 30 7-days, 10 daily	123 (15)	3.10-9.48/t/yr (372-1138 total)	Jain *et al*. 2007
Maple Ridge, New York	woodland, grassland, agricultural (195)	April 30 - November 14, 2007	64 weekly	64 (32)	5.67-6.31/t/yr (1106-1230)	Jain *et al.* 2008
Maple Ridge, New York	woodland, grassland, agricultural (195)	April 15 - November 9, 2008	64 weekly	74 (23)	3.42-3.76/t/yr (667-733)	Jain *et al.* 2009a
Mars Hill, Maine	forested ridgeline (28)	23 April- 3 June, 15 July-23 Sept 2007	2 of 28 daily, 28 of 28 weekly, seasonal dog searches	19 (3)	0.44-2.5/t/yr (26.8-69.2 total)	Stantec 2008
Mars Hill, Maine	forested ridgeline (28)	19 April- 6 June, 15 July-8 Oct 2008	28 of 28 weekly, seasonal dog searches	17(4)	2.4/t/yr-2.65/t/yr (57-74)	Stantec 2009
Munnsville, NY	agricultural and forested uplands	April 15-November 15, 2008	12 of 23 weekly, seasonal dog searches	7 (3)	1.71-2.22/t/yr (39.2-51.12)	Stantec 2009b
Mount Storm, WV	forested ridgeline (82)	July 18-October 17 2008	18 weekly, 9 daily	29 (8)	2.41-3.81/t/yr (198-312)	Young *et al.* 2009
Clinton, NY	agricultural, woodland (67)	April 26 to October 13, 2008	8 daily, 8 every 3-days, 7 every 7-days	14 (9)	1.43-2.48 small birds/t/yr (96 -166); 0.88 med-large birds/t/yr (59)	Jain et al. 2009b
Ellenburg, NY	agricultural, woodland (54)	April 28 to October 13, 2008	6 daily, 6 every 3-days, 6 every 7-days	12 (10)	0.92-1.10 small birds/t/yr (62-74); 0.77 med-large birds/t/yr (51)	Jain et al. 2009c
Bliss, NY	agricultural, woodland (67)	April 21 - Nov 14, 2008	8 daily, 8 every 3-days, 7 every 7-days	20 (7)	0.74-4.04 small birds/t/yr (50-271); 0.25-0.66 med-large birds/t/yr (17-44)	Jain et al. 2009d
Lempster, NH	forested ridgeline (12)	April 20 to June 1**	4 daily	1 (2)	not calculated for interim report	Tidhar 2009
*33 birds found on May 23, 2003 at turbines near a substation and at substation associated with sodium vapor lights						
**Results of spring interim report, study period April 20 to June 1.						

Appendix A Table 8. Vermont Fish and Wildlife Department (VFWD) listed species, indicating which species were detected in the Kingdom Community Wind Project area or region.

Common Name	Documented in region?	Documented on-site?	VFWD Listing	Additional Notes[1]
Rare and/or Priority Species documented in the Project area:				
Canada Warbler	BBS, eBird	SBBS, INC	WAP High Priority	Decreasing populations and unclear habitat requirements
Bay-breasted Warbler	- -	SBBS, INC	WAP Medium Priority	Population densities poorly understood, although moist, dense (often lowlad) spruce-fir is the preferred breeding habitat
Blackpoll Warbler	BBS, eBird	SBBS, RAP	WAP Medium Priority	Potential problems include habitat loss in montane coniferous forests
Black-throated Blue Warbler	BBS, eBird	SBBS, RAP	WAP Medium Priority	Population likely secure, although productivity decreases in fragmented habitats
Chimney Swift	BBS, eBird	SBBS	WAP Medium Priority	Declines in quality roosting habitat; highest declines statewide in northern Vermont populations
Ruffed Grouse	CBC, BBS, eBird	SBBS INC	WAP Medium Priority	No population data in Vermont, but declines in neighboring states
Veery	BBS, eBird	SBBS	WAP Medium Priority	Prefers deciduous floodplain forests
Rare and/or Priority Species not documented in the Project area, but documented in the region:				
American Woodcock	eBird	- -	WAP Medium Priority	Habitat area and quality declines at existing, moist-soil early-successional hardwood (especially alder and aspen-dominated sites) and open field habitats
Black-backed Woodpecker	CBC	- -	Special Concern	Uncommon resident: Thirty successful nesting pairs documented by Weinhagen (1998) in northeastern Vermont in 1996-97
Black-billed Cuckoo	BBS, eBird	- -	WAP Medium Priority	Population declines and uncommon breeder in Project vicinity
Bobolink	BBS, eBird	- -	WAP Medium Priority	
Brown Thrasher	BBS	- -	WAP Medium Priority	Population declines linked with succession to mature forests in New England
Chestnut-sided Warbler	BBS, eBird	- -	WAP Medium Priority	Highly specialized breeding habitat
Common Loon	BBS, eBird	- -	WAP High Priority	
Gray Jay	CBC, BBS	- -	Special Concern	Habitat generalist in large tracts of conifer forest and uplad elevation conifers
Great Blue Heron	BBS, CBC, eBird	- -	WAP Medium Priority	
Olive-sided Flycatcher	BBS, eBird	- -	WAP Medium Priority	Species seems to require disturbances in coniferous forests
Rusty Blackbird	BBS	- -	Special Concern	Population densities appear stable and disturbances can benefit this species
Vesper Sparrow	BBS	- -	Special Concern	
Wilson's Warbler	eBird	- -	Special Concern	
Wood Thrush	BBS, eBird	- -	WAP Meidum Priority	Common "umbrella" species with small population declines
Additional species of concern known to breed in similar habitats to the Project area:				
Spruce grouse	- -	- -	Endangered	Located at the southern end of geographic range; although records document spruce grouse historically in Orleans County, the species does not currently beed here
American three-toed woodpecker	- -	- -	Special Concern	
Bicknell's thrush	- -	- -	Special Concern	Population trends and habitat preferences unknown
Common nighthawk	- -	- -	Special Concern	Nests in clearings in conifer forests and hunts airspace over open and forested tracts

[1] Information taken from the Vermont Wildlife Actin Plan 2005.

BBS=USGS Breeding Bird Survey, CBC=Audubon Christmas Bird Count, RAP=raptor surveys, SBBS=Stantec Breeding Bird Surveys, INC=Incidentally observed during Stantec surveys

RTE Species=Globally rare, federally listed or proposed listed, have unique habitat requirements, or occur in the state at the extent of global range

Appendix A Table 9. Comparison bat mortality at existing wind farms in the east and upper mid-west, U.S.

Site	Habitat type (#	Dates	Search	# BATS	Estimated	Reference
Buffalo Ridge, Minnesota	agricultural grassland (73)	April 1994 - Dec 1995	30-50 weekly	n/a	n/a	Osborn *et al*. 2000
Buffalo Ridge, Minnesota (Phase 3)	agricultural grassland (138)	15 March - 15 November, 1999	30 every 14 days	n/a	n/a	Johnson *et al.* 2002
Buffalo Ridge, Minnesota	agricultural grassland (281)	15 June - 15 September, 2001 and 2002	83 of 103 bi-weekly	151	1.30-3.02/t/yr (364-849)	Johnson and Strickland 2004
Searsburg, Vermont	forested (11)	30 June - 18 October, 1997	11 total (4 per search) 2 to 6 days per month	0	n/a	Kerlinger 2002
Kewaunee County, Wisconsin	agricultural (31)	1999 - 2001	n/a	n/a	1.16-4.26/t/yr (36-132)	Sagrillo 2003, Sagrillo 2007
Somerset County, Pennsylvania	agricultural (8)	2000 (12 months)	n/a	0	n/a	Kerlinger 2006
Mountaineer, West Virginia	forested ridgeline (44)	4 April - 11 Nov, 2003	2x per week	475	47.53/t/yr (2092)	Kerns and Kerlinger, 2004
Mountaineer, West Virginia	forested ridgeline (44)	31 July- 11 September, 2004	22 daily, 22 weekly	398 (68)	38/t/yr (1364-1980)	Arnett 2005
Meyersdale, Pennsylvania	forested ridgeline (20)	2 August - 13 September, 2004	10 daily, 10 weekly	262 (37)	25/t/yr (400-660)	Arnett 2005
Top of Iowa, Iowa	agricultural (89)	24 March- 10 December, 2004	26 every 3-days	44 (n/a)	10.17/t/yr (905)	Koford et al. 2005
Buffalo Mtn, Tennessee	reclaimed mine on ridge (18)	April - December, 2005	18 of 18 every week, every 2 weeks, or every 2-5 days	243 (14)	63.9/t/yr (1,149)	Fiedler *et al.* 2007
Maple Ridge, New York	woodland, grassland, agricultural (120)	June 17 - November 15, 2006	10 every 3-days, 30 7-days, 10 daily	326 (58)	11.39-20.31/t/yr (1367-2437.2)	Jain *et al*. 2007
Maple Ridge, New York	woodland, grassland, agricultural (195)	April 30 - November 14, 2007	64 weekly	202 (81)	15.54-18.53/t/yr (3030-3614)	Jain *et al.* 2008
Maple Ridge, New York	woodland, grassland, agricultural (195)	April 15 - November 9, 2008	64 weekly	140 (76)	8.18 - 8.92/t/yr (1595-1739)	Jain *et al.* 2009a
Mars Hill, Maine	forested ridgeline (28)	23 April- 3 June, 15 July-23 Sept 2007	2 of 28 daily, 28 of 28 weekly, seasonal dog searches	22 (2)	0.43/t/yr-4.4/t/yr (12.1-122.5)	Stantec 2008
Mars Hill, Maine	forested ridgeline (28)	19 April- 6 June, 15 July-8 Oct 2008	28 of 28 weekly, seasonal dog searches	5	0.17/t/yr-0.68/t/yr (5-19)	Stantec 2009
Munnsville, NY	agricultural and forested uplands	April 15- November 15, 2008	12 of 23 weekly, seasonal dog searches	9 (1)	0.70-2.90/t/yr	Stantec 2009b
Mount Storm, WV	forested ridgeline (82)	July 18-October 17 2008	18 weekly, 9 daily	182 (27)	7.76-24.21/t/yr (636-1985)	Young *et al.* 2009
Clinton, NY	agricultural, woodland (67)	April 26 to October 13, 2008	8 daily, 8 every 3-days, 7 every 7-days	39 (14)	3.76-5.45/t/yr (252-365)	Jain et al. 2009b
Ellenburg, NY	agricultural, woodland (54)	April 28 to October 13, 2008	6 daily, 6 every 3-days, 6 every 7-days	34 (25)	3.37-6.59/t/yr (226-441)	Jain et al. 2009c
Bliss, NY	agricultural, woodland (67)	April 21 - Nov 14, 2008	8 daily, 8 every 3-days, 7 every 7-days	74 (15)	7.58-14.66/t/yr (508-983)	Jain et al. 2009d
Lempster, NH	forested ridgeline (12)	April 20 to June 1**	4 daily	1	not calculated for interim report	Tidhar 2009

*33 birds found on May 23, 2003 at turbines near a substation and at substation associated with sodium vapor lights

**Results of spring interim report, study period April 20 to June 1.

Appendix A Table 10. Summary of available spring bat detector surveys (results reported for individual detectors)

Year	Project	Project Location	Habitat	Height (m)	Detector Nights	Start	End	Calls	Rate	Reference
Tree or low tower detectors (10 m or below)										
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	5	21	4/5	6/12	16	0.8	Woodlot Alternatives, Inc. 2006. Summary of spring 2006 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated July 26, 2006.
2006	Howard	Howard, Steuben Cty, NY	field	8	35	4/15	6/3	29	0.8	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2005	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	10	4	5/12	5/29	0	0	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2006	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	8	38	4/24	6/13	840	22.1	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2006	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	9	37	4/24	6/13	90	2.4	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2006	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	8	34	4/24	6/13	178	5.2	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2006	Deerfield	Deerfield, Bennington Cty, VT	forest edge	2	37	4/14	6/11	4	0.1	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	3	21	4/23	5/22	34	1.6	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	3	29	4/23	5/22	16	0.6	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
Met tower detectors										
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	20	23	4/23	6/14	40	1.7	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	40	23	5/22	6/14	3	0.1	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	20	23	5/22	6/14	3	0.1	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	40	53	4/22	6/14	166	3.1	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2008	Rollins	Rollins, Penobscot Cty, ME	forest edge	20	53	4/22	6/14	106	2.0	Stantec Consulting Inc. 2008. Spring 2008 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2007	Ball Hill	Villenova, Chautauqua Cty, NY	field	40	32	3/28	5/30	4	0.1	Stantec Consulting Inc. 2007. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, NY. Prepared for Nobel
2007	Ball Hill	Villenova, Chautauqua Cty, NY	field	20	54	3/28	5/30	74	1.4	Stantec Consulting Inc. 2007. A Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, NY. Prepared for Nobel
2007	Stetson	Stetson, Penobscot Cty, ME	forest edge	30	47	4/24	6/18	52	1.1	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2007	Stetson	Stetson, Penobscot Cty, ME	forest edge	30	56	4/24	6/18	235	4.2	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2007	Stetson	Stetson, Penobscot Cty, ME	forest edge	30	56	4/24	6/18	36	0.6	Woodlot Alternatives, Inc. 2007. A Spring 2007 Survey of Bird and Bat Migration at the Stetson Wind Project, Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	50	14	5/4	6/19	0	0	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	50	24	5/4	6/19	0	0	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	20	35	5/4	6/19	31	0.7	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	50	35	5/4	6/19	0	0	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	40	60	4/5	6/12	7	0.1	Woodlot Alternatives, Inc. 2006. Summary of spring 2006 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated July 26, 2006.
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	20	50	4/5	6/12	3	0.1	Woodlot Alternatives, Inc. 2006. Summary of spring 2006 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated July 26, 2006.
2005	Cohocton/Dutch Hi	Cohocton, Steuben Cty, NY	field	30	29	5/2	5/30	21	0.7	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC
2005	High Sheldon	Sheldon, Wyoming Cty, NY	field	30	36	4/21	5/30	6	0.2	Woodlot Alternatives, Inc. 2006. A Spring 2005 Radar Survey of Bird Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.

Appendix A Table 10 Continued Summary of available spring bat detector surveys (results reported for individual detectors)

2005	Jordanville	Jordanville, Herkimer Cty, NY	field	30	29	4/14	5/13	15	0.5	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.
2005	Marble River	Churubusco, Clinton Cty, NY	field	30	46	4/14	5/30	12	0.3	Woodlot Alternatives, Inc. 2005. A Spring Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES
2005	Prattsburgh	Prattsburgh, Steuben Cty , NY	field	30	17	4/15	5/10	8	0.5	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind
2005	Prattsburgh	Prattsburgh, Steuben Cty , NY	field	15	20	4/11	5/30	8	0.4	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windfarm Prattsburgh Project in Prattsburgh, New York. Prepared for UPC Wind
2005	West Hill	Munnsville, Madison Cty, NY	field	30	22	5/10	5/31	6	0.3	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind,
2006	Chateaugay	Chateaugay, Franklin Cty, NY	field	40	54	4/16	6/8	117	2.2	Woodlot Alternatives, Inc. 2006. Spring 2006 Bat Surveys at the Proposed Brandon and Chateaugay Wind Farms in Northern New York. Prepared for Nobel Environmental Power, LLC and Ecology &
2006	Chateaugay	Chateaugay, Franklin Cty, NY	field	20	54	4/16	6/8	103	1.9	Woodlot Alternatives, Inc. 2006. Spring 2006 Bat Surveys at the Proposed Brandon and Chateaugay Wind Farms in Northern New York. Prepared for Nobel Environmental Power, LLC and Ecology &
2006	Brandon	Brandon, Franklin Cty, NY	field	15	38	4/7	6/4	848	22	Woodlot Alternatives, Inc. 2006. Spring 2006 Bat Surveys at the Proposed Brandon and Chateaugay Wind Farms in Northern New York. Prepared for Nobel Environmental Power, LLC and Ecology &
2006	Brandon	Brandon, Franklin Cty, NY	field	30	36	4/7	6/4	114	3.2	Woodlot Alternatives, Inc. 2006. Spring 2006 Bat Surveys at the Proposed Brandon and Chateaugay Wind Farms in Northern New York. Prepared for Nobel Environmental Power, LLC and Ecology &
2006	Howard	Howard, Steuben Cty, NY	field	50	36	4/15	6/4	5	0.1	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2006	Howard	Howard, Steuben Cty, NY	field	20	45	4/15	6/7	16	0.4	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2005	Horse Creek	Clayton, Jefferson Cty, NY	forest edge	20	42	4/20	5/31	55	1.3	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic
2005	Horse Creek	Clayton, Jefferson Cty, NY	forest edge	15	36	4/20	5/31	12	0.3	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic
2005	Moresville	Stamford, Delaware Cty, NY	forest edge	30	27	4/12	5/8	8	0.3	Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2005	Deerfield	Deerfield, Bennington Cty, VT	forest edge	15	40	4/19	6/15	4	0.1	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM
2005	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	20	31	5/1	5/31	6	0.2	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2006	Deerfield	Deerfield, Bennington Cty, VT	forest edge	35	60	4/14	6/13	4	0.1	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2006	Deerfield	Deerfield, Bennington Cty, VT	forest edge	15	47	4/14	5/31	0	0	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2006	Deerfield	Deerfield, Bennington Cty, VT	forest edge	30	29	4/14	5/20	0	0	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2006	Deerfield	Deerfield, Bennington Cty, VT	forest edge	15	21	4/14	5/16	7	0.3	Woodlot Alternatives, Inc. 2006. Spring 2006 Bird and Bat Migration Surveys at the Proposed Deerfield Wind Project in Searsburg and Readsboro, Vermont. Prepared for PPM Energy, Inc.
2006	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	31	36	4/24	6/13	5	0.14	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2005	Liberty Gap	Franklin, Pendleton Cty, WV	forest edge	30	21	4/17	6/7	2	0.1	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC.
2005	Liberty Gap	Franklin, Pendleton Cty, WV	forest edge	15	21	4/17	6/7	19	0.9	Woodlot Alternatives, Inc. 2005. A Spring 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia. Prepared for US Wind Force, LLC.
2006	Wethersfield	Wethersfield, Wyoming Cty, NY	field	21	63	4/6	6/7	60	1.0	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and
2006	Wethersfield	Wethersfield, Wyoming Cty, NY	field	10	63	4/6	6/7	132	2.1	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and
2006	Centerville	Centerville, Allegany Cty, NY	field	25	63	4/6	6/8	139	2.2	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment,
2006	Centerville	Centerville, Allegany Cty, NY	field	10	63	4/6	6/8	131	2.1	Woodlot Alternatives, Inc. 2006. A Spring 2006 Survey of Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment,
2007	Coos	Coos Cty, NH	forest edge	50	37	4/26	6/1	8	0.2	Stantec Consulting Inc. 2007. Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC.
2007	Coos	Coos Cty, NH	forest edge	20	19	4/30	6/1	5	0.3	Stantec Consulting Inc. 2007. Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC.
2007	Coos	Coos Cty, NH	forest edge	30	35	4/28	6/1	8	0.2	Stantec Consulting Inc. 2007. Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC.
2007	Coos	Coos Cty, NH	forest edge	15	35	4/28	6/1	12	0.3	Stantec Consulting Inc. 2007. Spring 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Windpark in Coos County, New Hampshire by Granite Reliable Power, LLC.

Appendix A Table 11. Summary of available fall bat detector surveys (results reported for individual detectors)

Year	Project	Project Location	Habitat	Height (m)	Detector Nights	Start	End	Calls	Rate	Reference
Tree or Low Tower detectors (10 m or below)										
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	3	114	7/12	11/2	12291	107.8	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	3	53	8/2	10/16	5360	101.1	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	3	107	7/12	11/2	8996	84.1	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2005	Lempster	Lempster, Sullivan Cty, NH	forest edge	7.5	34	9/20	10/31	27	0.8	Woodlot Alternatives, Inc. 2005. Summary of fall 2005 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated November 18, 2005.
2005	Lempster	Lempster, Sullivan Cty, NH	forest edge	2	42	9/20	10/31	2	0	Woodlot Alternatives, Inc. 2005. Summary of fall 2005 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated November 18, 2005.
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	10	29	9/9	10/24	2	0.1	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Lempster Mountain Wind Power Project in Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	3	44	9/9	10/24	384	8.7	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Lempster Mountain Wind Power Project in Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
2005	High Sheldon	Sheldon, Wyoming Cty, NY	field	2	49	8/1	10/4	5535	113	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
2005	Howard	Howard, Steuben Cty, NY	field	2	25	8/3	8/27	1493	51.5	Woodlot Alternatives, Inc. 2005. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2005	Jordanville	Jordanville, Herkimer Cty, NY	field	2	34	8/12	9/22	124	4.4	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.
2005	Marble River	Churubusco, Clinton Cty, NY	field	10	34	8/1	10/11	150	4.4	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
2005	Marble River	Churubusco, Clinton Cty, NY	field	2	18	8/1	10/11	113	6.3	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
2005	Top Notch	Fairfield, Herkimer Cty, NY	field	2	34	8/19	9/21	44	1.3	Woodlot Alternatives, Inc. 2005. A Summer and Fall 2005 Radar and Acoustic Surveys of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.
2005	West Hill	Munnsville, Madison Cty, NY	field	2	30	8/1	10/21	10	0.3	Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
2005	Horse Creek	Clayton, Jefferson Cty, NY	forest edge	2	33	8/19	9/20	154	4.7	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
2005	Moresville	Stamford, Delaware Cty, NY	forest edge	2	58	8/15	10/15	280	4.8	Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	2	13	8/9	8/21	148	11.4	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	5	4	8/9	8/21	1	0.3	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	3	13	8/9	8/21	524	40.3	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	10	13	8/9	8/21	1576	121.2	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
MET Tower Detectors										
2007	Ball Hill	Villenova, Chautauqua Cty, NY	field	40	77	7/30	10/14	246	3.2	Stantec Consulting Services Inc. 2008. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment, Inc.
2007	Ball Hill	Villenova, Chautauqua Cty, NY	field	20	77	7/30	10/14	295	3.8	Stantec Consulting Services Inc. 2008. A Fall 2007 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Ball Hill Windpark in Villenova and Hanover, New York. Prepared for Noble Environmental Power, LLC and Ecology and Environment, Inc.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	45	46	8/22	10/18	7	0.2	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	20	58	8/22	10/18	93	1.6	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	45	59	8/22	10/19	18	0.4	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.

Appendix A Table 11 Continued Summary of available fall bat detector surveys (results reported for individual detectors)

2007	Record Hill	Roxbury, Oxford Cty, ME	forest edge	20	59	8/22	10/19	252	5.1	Stantec Consulting Services Inc. 2007. Fall 2007 Migration Report: Visual, Acoustic and Radar Surveys of Bird and Bat Migration Conducted at the Proposed Record Hill Wind Project in Roxbury, Maine. Prepared for Independence Wind, LLC.
2005	Dans Mountain	Loarville, Allegany Cty, MD	forest edge	11	53	8/1	9/22	574	10.8	Woodlot Alternatives, Inc. 2005. Fall 2005 Bat Echolocation Surveys at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force.
2005	Dans Mountain	Loarville, Allegany Cty, MD	forest edge	23	31	8/1	9/22	388	12.5	Woodlot Alternatives, Inc. 2005. Fall 2005 Bat Echolocation Surveys at the Proposed Dan's Mountain Wind Project in Frostburg, Maryland. Prepared for US Wind Force.
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	40	95	7/12	11/2	66	0.7	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2007	Rollins	Rollins, Penobscot Cty, ME	forest edge	20	106	7/12	11/2	155	1.5	Stantec Consulting Services Inc. 2007. Fall 2007 Bird and Bat Migration Survey Report: Visual, Radar and Acoustic Bat Surveys for the Rollins Wind Project. Prepared for FirstWind Management, LLC.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	45	72	6/20	10/25	18	0.3	Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	45	76	6/20	10/25	0	0	Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	20	44	6/20	10/25	4	0.1	Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc.
2006	Kibby	Kibby, Franklin Cty, ME	forest edge	45	20	6/20	10/25	0	0	Woodlot Alternatives, Inc. 2006. Summer/Fall 2006 Survey of Bat Activity at the Proposed Kibby Wind Power Project in Kibby and Skinner Townships, Maine. Prepared for TransCanada Maine Wind Development Inc.
2006	Redington	Redington, Franklin Cty, ME	forest edge	15	21	8/10	10/24	0	0	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power.
2006	Redington	Redington, Franklin Cty, ME	forest edge	15	48	8/10	10/24	0	0	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power.
2006	Redington	Redington, Franklin Cty, ME	forest edge	30	29	8/10	10/24	0	0	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power.
2006	Redington	Redington, Franklin Cty, ME	forest edge	30	37	8/10	10/24	0	0	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Redington Wind Project. Prepared for Maine Mountain Power.
2006	Stetson	Stetson, Penobscot Cty, ME	forest edge	30	73	6/28	10/16	8	0.1	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2006	Stetson	Stetson, Penobscot Cty, ME	forest edge	30	76	6/28	10/16	170	2.2	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2006	Stetson	Stetson, Penobscot Cty, ME	forest edge	15	105	6/28	10/16	108	1	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2006	Stetson	Stetson, Penobscot Cty, ME	forest edge	15	107	6/28	10/16	651	6.1	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Stetson Mountain Wind Power Project in Washington County, Maine. Prepared for Evergreen Wind V, LLC.
2005	Lempster	Lempster, Sullivan Cty, NH	forest edge	15	42	9/20	10/31	14	0.3	Woodlot Alternatives, Inc. 2005. Summary of fall 2005 Lempster bat survey. Memorandum to Jeff Keeler (CEI) from Bob Roy (Woodlot Alternatives, Inc.) dated November 18, 2005.
2006	Lempster	Lempster, Sullivan Cty, NH	forest edge	40	43	9/9	10/24	16	0.4	Woodlot Alternatives, Inc. 2007. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Lempster Mountain Wind Power Project in Lempster, New Hampshire. Prepared for Lempster Wind, LLC.
2006	Brandon	Brandon, Franklin, Cty, NY	field	12	62	7/25	10/4	1287	20.8	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Brandon and Chateaugay Windparks in Western New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2005	High Sheldon	Sheldon, Wyoming Cty, NY	field	15	65	8/1	10/4	335	5.2	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
2005	High Sheldon	Sheldon, Wyoming Cty, NY	field	30	58	8/1	10/4	137	2.4	Woodlot Alternatives, Inc. 2006. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed High Sheldon Wind Project in Sheldon, New York. Prepared for Invenergy.
2005	Howard	Howard, Steuben Cty, NY	field	30	13	8/3	8/19	30	2.3	Woodlot Alternatives, Inc. 2005. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2005	Howard	Howard, Steuben Cty, NY	field	27	15	8/3	8/14	30	2	Woodlot Alternatives, Inc. 2005. A Fall 2005 Survey of Bird and Bat Migration at the Proposed Howard Wind Power Project in Howard, New York. Prepared for Everpower Global.
2005	Jordanville	Jordanville, Herkimer Cty, NY	field	15	34	8/12	9/22	143	4.2	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.
2005	Jordanville	Jordanville, Herkimer Cty, NY	field	30	41	8/12	9/22	255	6.2	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Jordanville Wind Project in Jordanville, New York. Prepared for Community Energy, Inc.
2005	Marble River	Churubusco, Clinton Cty, NY	field	20	39	8/1	10/11	243	6.2	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Marble River Wind Project in Clinton and Ellenburg, New York. Prepared for AES Corporation.
2005	Top Notch	Fairfield, Herkimer Cty, NY	field	15	34	8/19	9/21	30	0.9	Woodlot Alternatives, Inc. 2005. A Summer and Fall 2005 Radar and Acoustic Surveys of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.
2005	Top Notch	Fairfield, Herkimer Cty, NY	field	30	34	8/19	9/21	99	3	Woodlot Alternatives, Inc. 2005. A Summer and Fall 2005 Radar and Acoustic Surveys of Bird and Bat Migration at the Proposed Top Notch Wind Project in Fairfield, New York. Prepared for PPM Atlantic Renewable.

Appendix A Table 11 Continued Summary of available fall bat detector surveys (results reported for individual detectors)										
2005	West Hill	Munnsville, Madison Cty, NY	field	15	47	8/1	10/21	179	3.8	Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
2005	West Hill	Munnsville, Madison Cty, NY	field	30	52	8/1	10/21	106	2	Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
2006	Steuben	Hartsville, Steuben Cty, NY	field	15	76	7/26	10/10	119	1.6	Environmental Design and Research (RD&R). 2006. Draft Environmental Impact Statement for the Cohocton Wind Power Project. Town of Cohocton, Steuben County, New York, Prepared for Canandaigua Wind Partners, LLC.
2006	Steuben	Hartsville, Steuben Cty, NY	field	30	49	7/26	10/10	84	1.7	Environmental Design and Research (RD&R). 2006. Draft Environmental Impact Statement for the Cohocton Wind Power Project. Town of Cohocton, Steuben County, New York, Prepared for Canandaigua Wind Partners, LLC.
2006	Wethersfield	Wethersfield, Wyoming Cty, NY	field	15	54	7/25	10/9	0	0	Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Wethersfield	Wethersfield, Wyoming Cty, NY	field	30	26	7/25	10/9	22	0.8	Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Brandon	Brandon, Franklin, Cty, NY	field	25	72	7/25	10/4	464	6.4	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Brandon and Chateaugay Windparks in Western New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Centerville	Centerville, Allegany Cty, NY	field	15	48	7/25	10/10	2	0	Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Centerville	Centerville, Allegany Cty, NY	field	35	41	7/25	10/10	3	0.1	Woodlot Alternatives, Inc. 2006. A Fall 2006 Survey of Bird and Bat Migration at the Proposed Centerville and Wethersfield Windparks in Centerville and Wethersfield, New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Chateaugay	Chateaugay, Franklin Cty, NY	field	40	58	7/25	10/4	173	3	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Brandon and Chateaugay Windparks in Western New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Chateaugay	Chateaugay, Franklin Cty, NY	field	20	44	7/25	10/4	345	7.8	Woodlot Alternatives, Inc. 2006. Fall 2006 Bat Detector Surveys at the Proposed Brandon and Chateaugay Windparks in Western New York. Prepared for Ecology and Environment, Inc. and Noble Power, LLC.
2006	Cohocton/Dutch Hill	Cohocton, Steuben Cty, NY	field	15	43	8/12	10/11	46	1.1	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC.
2006	Cohocton/Dutch Hill	Cohocton, Steuben Cty, NY	field	30	47	8/12	10/11	57	1.2	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Cohocton Wind Power Project in Cohocton, New York. Prepared for UPC Wind Management, LLC.
2005	Clayton	Clayton, Jefferson Cty, NY	forest edge	30	0	8/19	9/20	0	0	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Clayton Wind Project in Clayton, New York. Prepared for PPM Atlantic Renewable.
2005	Munnsville	Munnsville, Madison Cty, NY	field	23	67	7/31	10/16	280	0.2	Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
2005	Munnsville	Munnsville, Madison Cty, NY	field	15	67	7/31	10/16	210	0.3	Woodlot Alternatives, Inc. 2005. Summer and Fall 2005 Bird and Bat Surveys at the Proposed Munnsville Wind Project in Munnsville, New York. Prepared for AES-EHN NY Wind, LLC.
2005	Moresville	Stamford, Delaware Cty, NY	forest edge	15	43	8/15	10/15	293	6.8	Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2005	Moresville	Stamford, Delaware Cty, NY	forest edge	30	54	8/15	10/15	285	5.3	Woodlot. 2007. A Spring and Fall 2005 Radar and Acoustic Survey of Bird Migration at the Proposed Moresville Energy Center in Stamford and Roxbury, New York. Prepared for Invenergy, LLC. Rockville, MD.
2004	Liberty Gap	Franklin, Pendleton Cty, WV	forest edge	15	14	Sep	Nov	168	0.35	Woodlot Alternatives, Inc. 2005. A Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia – Fall 2004. Prepared for US Wind Force, LLC.
2004	Liberty Gap	Franklin, Pendleton Cty, WV	forest edge	30	14	Sep	Nov	165	0.19	Woodlot Alternatives, Inc. 2005. A Radar and Acoustic Survey of Bird and Bat Migration at the Proposed Liberty Gap Wind Project in Franklin, West Virginia – Fall 2004. Prepared for US Wind Force, LLC.
2004	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	15	6	9/10	9/15	30	0.23	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2004	Sheffield	Sheffield, Caledonia Cty, VT	forest edge	30	5	10/17	10/21	0	0	Woodlot Alternatives, Inc. 2006. Avian and Bat Information Summary and Risk Assessment for the Proposed Sheffield Wind Power Project in Sheffield, Vermont. Prepared for UPC Wind Management, LLC.
2005	Mars Hill	Mars Hill, Aroostook Cty, ME	forest edge	20	22	8/31	9/21	25	n/a	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC.
2005	Mars Hill	Mars Hill, Aroostook Cty, ME	forest edge	20	22	8/31	9/21	25	n/a	Woodlot Alternatives, Inc. 2005. A Fall 2005 Radar, Visual, and Acoustic Survey of Bird and Bat Migration at the Proposed Mars Hill Wind Project in Mars Hill, Maine. Prepared for UPC Wind Management, LLC.

Appendix B

Potential Risk of Impact by Bird Species

Appendix B Table 1. Nocturnally migrating passerines at increased potential risk of impact* due to collision during nocturnal migration at Kingdom Community Wind Project

Species	Risk Factor	Exposure Pathway	Applicable information
Red-eyed vireo	Abundance and high mortality at existing wind farms in the east	migration path through project area expected	commonly killed during nocturnal migration by collision with tall structures, among most common species killed at communication towers in Florida, 280 killed at one tower in a single night represented 9.6% of fatalities at Maple Ridge, NY (Jain et al. 2007), represented 30% of fatalities at Mountaineer, WV (Kerns and Kerlinger 2004), represented 25% of fatalities at Buffalo Mountain, Tennessee (Fiedler et al. 2007) Abundant and widespread across its range, BBS data suggest increasing populations in East (Cimprich
Golden-crowned kinglet	relatively high mortality at existing facilities in the east	migration path through project area expected	represented 39% of fatalities at Maple Ridge, NY (Jain et al. 2007) and 9% of fatalities at a wind farm in the Northeast (Stantec/Woodlot, unpublished data) relatively stable population in the east, though declines observed in the west (Ingold and Galati 1997)
Magnolia warbler	relatively high mortality at existing wind farms	migration path through project area expected	relatively high mortality, represented 7% of total fatalities at Mountaineer (Kerns and Kerlinger 2004) fairly common fatalities at communication towers, over 1,000 found during 2 search days at a Wisconsin communication tower in 1963; and over 1,000 found at lighted buildings and wires in Texas (Hall 1994) BBS data indicate a relatively stable population (Hall 1994)
Rose-breasted grosbeak	relatively high mortality at existing facilities in the east	migration path through project area expected	relatively high mortality at a wind farm in the east, represented 17% of fatalities at a wind farm in Tennessee (Fiedler et al. 2007) 69 reported fatalities at communication towers in Florida over 25 years (Wyatt and Francis 2002) BBS data suggest a relatively stable population (Wyatt and Francis 2002)
Cedar waxwing	relatively high mortality at existing facilities in the	migration path through project area expected	6.9% of total avian mortality at Mount Storm Wind Energy Facility (Young et al. 2009) evidence of mortality during nocturnal migration from communication-tower strike (Witmer et al. 1997)
Cape May warbler	relatively high mortality at existing facilities in the	migration path through project area expected	6.9% of total avian mortality at Mount Storm Wind Energy Facility (Young et al. 2009) evidence of mortality during nocturnal migration from communication-tower strike (Baltz and Latta 1998)
European starling	Abundance and high mortality at existing wind	migration path through project area expected	relatively high mortality observed during Maple Ridge, NY 2008 monitoring season (Jain et al. 2008)
Vesper sparrow	species of conservation concern, high mortality at some facilities in the U.S.	migration path through project area expected	relatively low mortality at communication towers, overall 191 kills documented (Jones and Cornely 2002) relatively high mortality observed at existing sites in the West and Midwest, but in areas where relatively common (NRC 2007) BBS data suggest significant declines in Eastern region, likely due to loss of grassland or mowing of grassland habitat (Jones and Cornely 2002)
Black-throated green warbler	abundance	migration path through project area expected	collision reported at existing facility in the Northeast (Stantec/Woodlot, unpublished data) BBS data suggests a relatively stable population range wide (Morse 2005)
Ovenbird	abundance	migration path through project area expected	susceptibility to collision unknown BBS data suggest significant population declines (Van Horn and Donovan 1994)
Chestnut-sided warbler	abundance	migration path through project area expected	hundreds known to collide with smokestakes, buildings, and communicaiton towers (Richardson and Brauning 1995) population generally showing slight decreases (Richardson and Brauning 1995)
American redstart	abundance	migration path through project area expected	nocturnal migrant, known to collide with communication towers (Sherry and Holmes 1997) populations currently in fluctuation with unknown causes (Sherry and Holmes 1997)
Yellow-bellied sapsucker	abundance	migration path through project area expected	nocturnal migrant, known to collide with communication towers (Walters et al. 2002) Appalachian region population declines (Walters et al. 2002)
Olive-sided flycatcher	species of conservation concern	migration path through project area expected	BBS data suggest broad-scale population declines in many physiographic regions (Altman and Sallabanks 2000) incomplete understanding of migration routes and population viability
White-throated sparrow	abundance	migration path through project area expected	known to collide with communication towers and lighted buildings (Falls and Kopachena 1994) generally declining through most of range (Falls and Kopachena 1994)
Nashville warbler	abundance	migration path through project area expected	over 100 birds known to collide with a 7 different communication towers on a single night (Williams population appears generally stable (Williams 1996b)
Blackburnian warbler	abundance	migration path through project area expected	relatively stable populations (Morse 2004) blackburnian warbler represented 9% of bird mortality at a wind farm in the Northeast (Stantec/Woodlot, unpublished data)
Black-and-white warbler	abundance	migration path through project area expected	known to collide with wind turbines (Stantec, unpublished data) common and widespread, generally stable population (Kricher 1995)
Blue-headed vireo	abundance	migration path through project area expected	relatively small numbers of collisions at communication towers during migration (James 1998) populations generally increasing (James 1998)
Northern flicker	abundance	migration path through project area expected	primarily nocturnal migrant population generally declining (Moore 1995)
Wood thrush	species of conservation concern	migration path through project area expected	reported collisions with communication towers and windows (Roth et al. 1996) population has been declining substantially across its range
Swainson's thrush	species of conservation concern	migration path through project area expected	collisions with buildings and communication towers during migration considered source of significant mortality (Mack and Yong 2000) population generally declining (Mack and Yong 2000)

*RTE species in the region, species with high mortality rates at existing wind farms, species that exhibit flight behaviors that put them at increased risk, and species that have high abundance in the project area

Appendix B Table 2. Non-raptor breeding bird species at increased potential risk of impact* due to collision mortality at Kingdom Community Wind Project

Species	Risk Factor	Exposure Pathway	Applicable information
Ovenbird	abundance	documented occurrence in project area, abundance, courtship flights	primarily low flights in forest, quick manuverability around trees (Van Horn and Donovan 1994)
			forages in leaf litter on the forest floor or in low vegetation (Van Horn and Donovan 1994)
			evening courtship display flights (Van Horn and Donovan 1994)
Rose-breasted grosbeak	relatively high mortality at existing wind farms in the east	documented occurrence in project area	forages in canopy and understory vegetation, occassionally on the ground (Wyatt and Francis 2002)
			BBS data suggest a relatively stable population (Wyatt and Francis 2002)
			relatively high mortality at a wind farm in the east, represented 17% of fatalities at a wind farm in Tennessee (Fiedler et al. 2007)
Red-eyed vireo	Abundance and high mortality at existing wind farms in the east	documented occurrence in project area, abundance	relatively high mortality among existing wind farms in the East (Jain et al. 2007, Kerns and Kerlinger 2004, Fiedler et al. 2007)
			Abundant and widespread across its range, BBS data suggest increasing populations in East (Cimprich 2000)
			hops along branches in forest canopy or makes short flights in shrubby understory while foraging (Cimrich 2000)
Common nighthawk	species of conservation concern	breeding records on coniferous summits in New England	small numbers of mortality documented at communication tower sites (Poulin et al. 1996)
			males feed at heights up to 175m with spiraling downward descents (Poulin et al. 1996)
Canada warbler	species of conservation concern	documented occurrence in project area	prefers many types of mixed forest, often moist with thick understories (Conway 1999)
			documented mortality associated with strikes with stationary objects (Conway 1999)
Chestnut-sided warbler	abundance	documented occurrence in project vicinity	foliage gleaner, forages on the ground as well as in canopy, particularly in shrubby areas - hops and perches (Richardson and Brauning 1995)
			exhibits territorial and courtship chasing (Richardson and Brauning 1995)
			population generally showing slight decreases (Richardson and Brauning 1995)
Black-throated blue warbler	abundance	documented occurrence in project area	primarily low flights in forest, generally under canopy or quick tree-to-tree movements (Holmes et al.
			populations generally stable with highest breeding densities in forests with dense shrub layer (Holmes et al. 2005)
Chimney swift	species of conservation concern	documented occurrence in project area, foraging exposure	aerial feeder at various heigts above canopy; recorded at altitudes of 2,134 m (Cink and Collins 2002)
			courtship- and "trio-flights" recorded to 150 m (Cink and Collins 2002)
Blackburnian warbler	abundance and high mortality at existing wind farms in the east	documented occurrence in project area	blackburnian warbler represented 9% of bird mortality at a wind farm in the Northeast (Stantec/Woodlot, unpublished data)
			males may perform courtship gliding (Morse 2004)
			forages in tall trees, rarely 'hawks' for insects (Morse 2004)
			relatively stable populations (Morse 2004)
Blackpoll warbler	species of conservation concern	documented occurrence in project area; local abundance	subalpine conifer breeder, often dense populations (Hunt 1999)
			population data uncertain due to small smaple sizes (Hunt 1999)
Bay-breasted warbler	species of conservation concern	documented occurrence in project area	inhabits conifer summits of ridgelines at southern breeding limit (Williams 1996a)
			foliage gleaner in dense conifer branches (Williams 1996a)
Black-and-white warbler	abundance	documented occurrence in project area	foliage gleaner and bark creeper (Kricher 1995)
			territorial and courtship chasing (Kricher 1995)
			common and widespread, generally stable population (Kricher 1995)
Blue-headed vireo	abundance	documented occurrence in project vicinity	populations generally increasing (James 1998)
			forages mainly at mid-tree height (James 1998)
			moves slowly and deliberately from perch to perch or tree to tree (James 1998)
			short distances territorial chasing (James 1998)
Northern flicker	abundance	documented occurrence in project vicinity; abundance	population generally declining (Moore 1995)
			collisions with man-made objects not believed to be significant source of mortality (Moore 1995)
Magnolia warbler	relatively high mortality at existing wind farms	documented occurrence in project area	relatively high mortality, represented 7% of total fatalities at Mountaineer (Kerns and Kerlinger 2004)
			territorial displays occasionally involve chases and flights (Hall 1994)
			faily commonly collides with communication towers and buildings (Hall 1994)
			BBS data indicate a relatively stable population (Hall 1994)
			feeds mid-height in conifer trees and shrubs (Hall 1994)
Black-capped chickadee	abundance	documented occurrence in project area, abundance	most flights are short and not significantly higher than canopy height
			BBS data suggest population is increasing in eastern range (Smith 1993)
Ruffed grouse	relatively high mortality at existing wind farms	documented occurrence in project area, abundance	mortality has been observed at existing wind farms (Jain et al. 2007)
Wild Turkey	abundance	documented occurrence in region	although not generally a high flier, turkeys don't have great manueverability in flight (Eaton 1992)
			3.4% of total avian mortality at Mount Storm Wind Energy Facility (Young et al. 2009)

*RTE species in the region, species with high mortality rates at existing wind farms, species that exhibit flight behaviors that put them at increased risk, and species that have high abundance in the project area

Appendix B Table 3. Non-raptor breeding bird species at higher potential risk of indirect effects due to loss of habitat or disturbance at Kingdom Community Wind Project

Species	Risk Factor	Predicted Effect	Applicable information
Forest edge and early successional habitat			
Chestnut-sided warbler	Abundance	Increase in suitable habitat	responds positively to a variety of habitat changes, flourishes in clearcuts allowed to regenerate (Richardson and Brauning 1995)
			population generally showing slight decreases (Richardson and Brauning 1995)
American robin	Abundance	Increase in suitable habitat	increased in abundance prior to construction of VT facility (Kerlinger 2002)
			stable and increasing population in the east (Sallabanks and James 1999)
			land uses such as forest harvesting, agriculture, and urbanization have increased habitat (Sallanbanks and James 1999)
American redstart	Abundance and quality local habitat	Undetermined effect	prefers "mid-aged" succesional forest habitat, often moist or riparian and deciduous or deciduous-mixed canopy; does not appear to avoid edge (Sherry and Holmes, 1997)
			displays "Area-sensitive" habitat choices in many parts of breeding range (Sherry and
Hermit thrush	Abundance	Increase in suitable habitat	a forest interior bird which favors interior edges, particularly at drier sites such as anthropogenic-, wind- and fire-openings (Jones and Donovan, 1996)
			BBS data suggest positive population trends (Jones and Donovan, 1996)
Black-capped chickadee	Abundance	Increase in suitable habitat	1993)
			primarily arboreal foliage and bark gleaner
			BBS data suggest population is increasing in eastern range (Smith 1993)
			forest clearing increases forest edge habitat which benefits chickadees (Smith 1993)
Dark-eyed junco	Abundance	Little influence	a habitat generalist found in open woodlands (especially conifer), regenerating stands and edges (Nolan et al 2002)
			forest-management and moderate anthropogenic disturbance generally has little influence in nesting or habitat use by juncos (Nolan et al 2002)
Common yellowthroat	observed displacement at existing facility	Increase in suitable habitat, but potential behavioral displacement	observed to have decreased use of area surrounding turbines (100 m radius) at Buffalo Ridge, Minnesota (NRC 2007, Johnson et al. 2000)
			2000)
			temporarily benefits from areas where thick vegetation growth is promoted by disturbance such as the removal of canopy (timber harvesting) (Guzy and Ritchison 1999)
			BBS data suggest slight population decreases in eastern region (Guzy and Ritchison 1999)
Forest habitat			
Ovenbird	Abundance	Decrease in suitable habitat	observed impacts from forest harvesting practices (NRC 2007)
			threatened by reduction of extensive tracts of forest and fragmentation (Van Horn and Donovan 1994)
			sensitive to cowbird brood parasitism (Van Horn and Donovan 1994)
			one of most abundant species prior to construction of the Searsburg, Vermont windfarm but suffered a decline in abundance after construction (Kerlinger 2002)
			BBS data suggest significant population declines (Van Horn and Donovan 1994)
Black-throated Blue Warbler	Abundance	Fragmentation of suitable habitat	breeds in relatively intact, mature northern hardwood forest, often montaine with shrubby understory (Holmes and Sillett, 2005)
			area sensitive, occuring primarily in forest tracts > 100ha (Robbins et al 1989); although found to frequently cross roads and habitat gaps (Harris and Reed, 2002b)
			forest interior birds found to have higher reproductive productivity than those breeding near edges, although due to pairing success in edge habitats, both seem to have similar probabilities of producing fledglings (Harris and Reed, 2002a)
Red-eyed vireo	Abundance and high mortality at existing wind farms in the east	Decrease in suitable habitat, potential avoidance	populations apparently not impacted by small scale disturbances to habitat, were observed to tolerate small and narrow clearcuts of 2-10 hectares, larger scale clear-cuts have resulted in decreases in breeding populations (Cimprich et al. 2000)
			susceptible to cowbird brood parasitism (Cimprich et al. 2000)
			one of most abundant species prior to construction of the Searsburg, Vermont windfarm but suffered a decline in abundance after construction (Kerlinger 2002)
			disturbed by isolation of forest fragments, athough have been found breeding in fragments as small as 0.5 hectares (Cimprich et al. 2000)
			abundant and widespread across its range, BBS data suggest increasing populations in East (Cimprich 2000)
Blackburnian warbler	Abundance	Decrease in suitable habitat	occurs in coniferous to coniferous-deciduous mixed forest primarily, often in late successional stands (Morse 2004)
			an interior-forest species sensitive to fragmentation and the removal of large conifers (Morse 2004)
Blue-headed vireo	Abundance	Decrease in suitable habitat	occurs in conifer and mixed forests, particularly old growth conifer forests and riparian hemlock forests (PGC 2005)
			occurs in stratified forests and is sensitive to edge effects (PGC 2005)
			populations generally increasing (James 1998)
			sensitive to clearing of forests and fragmentation (James 1998)
			1998)
Northern flicker	Abundance	Decrease in suitable habitat	prefers forest edge and open woodlands (Moore 1995)
			population generally declining (Moore 1995)
			sensitive to loss of snags, trees with dead limbs, and live trees with core rot for nesting (Moore 1995)
Wood thrush	Species of conservation concern	Decrease in suitable habitat	occurs in both desciduous and mixed forests, it is an indicator species for high quality forests (PGC 2005)
			suceptible to fragmentation, significantly less abundant at edges bordered by paved road and powerlines than along narrow unpaved roads (Roth et al. 1996)
			will use fragments if intact canopy and dense understory occur, although susceptible to predation and brood parasitism (Roth et al. 1996)
			sensitive to nest abandonment if disturbances occur around the nest (Roth et al. 1996)
			population has been declining substantially across its range

*RTE species in the region, species with high mortality rates at existing wind farms, species that exhibit flight behaviors that put them at increased risk, and species that have high abundance in the project area